# AUTOMOTIVE INDUSTRIES

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DECEMBER 1, 1940

# HELPS KEEP PLANT AT PEAK

## PRODUCTION

● BECAUSE production of machine tools has become all important, the following statement of a midwestern manufacturer on his experience with Superla Soluble Oil is doubly significant right now. He says:

"Superla Soluble Oil is helping to keep this plant at peak production by its fine cooling properties and its ability to make fine finishes possible."

As further proof of the adaptability of Superla to many jobs the writer says:

"Machining a clutch gear blank (see illustration) on a Gisholt 1L High Production Turret Lathe with the aid of Superla Soluble Oil is just one of the countless applications in our shops. Every job must be held to close tolerances, and the 10-year experience which we have had with Superla has shown conclusively that its use is a big help in maintaining the accuracy built into these machines, since it will not cause the hardened steel ways to rust or gum up."

For more complete information on how Standard Oil Engineers and Standard Oil products can help *you* get "peak production" call the nearest Standard Oil (Indiana) office or write 910 So. Michigan Ave., Chicago, Ill., for the engineer nearest you. In Nebraska write Standard Oil of Nebraska at Omaha.




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# AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Published Semi-Monthly

Volume 83 Number 11




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# Reamer Life DOUBLED!

## *Finish—Better Than Before*

**FRONT AXLE STEERING KNUCKLE** upper arm rough reamed at a 100% saving in tool life . . . Thanks to *Texaco Sultex Cutting Oil.*

IN REAMING steering knuckle arms on 3-spindle Baker Drill Press, roughing reamer life has been increased from 100 to 200 pieces. Finish reamer life to 277 pieces. The finish is better than before.

These improvements have resulted solely from changing over to *TEXACO SULTEX CUTTING OIL B.*

Getting down between the work and the tool, *Texaco Sultex* cools by reducing friction, thus preventing the chips from welding to the tool and spoiling the finish. Tools stay sharp, cool, smooth-cutting.

Our cutting oil engineers will gladly cooperate in making savings with *Texaco Sultex Cutting Oils and Texaco Soluble Oils* in your plant. Phone the nearest of more than 2300 Texaco warehousing points in the 48 States, or write:

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TEXACO DEALERS INVITE YOU TO ENJOY

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TEXACO

**TEXACO SULTEX CUTTING OILS SOLUBLE OILS**

# IN THIS ISSUE . . .

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Volume 83 December 1, 1940 Number 11

**Tilt Honored** Two hundred executives of the automotive and associated industries honored Charles Arthur Tilt, founder and head of The Diamond T Motor Car Company, Chicago, for 35 years, with a testimonial dinner in Chicago's Union League Club, on Nov. 5. Arrangements for the banquet had been kept secret and its surprise, coupled with the enthusiasm of the guests made it a dramatic event for the guest of honor.

"Mr. Tilt is the oldest executive in continuity of service in the truck industry and he, more than any other man, is responsible for the present-day styling and eye-appeal of American trucks," said John P. Kelley, of A. O. Smith Corporation, the toastmaster. "Mr. Tilt's service to the industry has been of inestimable value and Diamond T and the J. E. Tilt Shoe Company, representing two generations of the Tilt family, have made an outstanding contribution to industrial Chicago."

Other informal talks were made by H. E. Hendrickson, Mather Spring Company; Charles Oppe, G. & O. Manufacturing Company; Willard F. Rockwell, Timken-Detroit Axle Company; Roy Faulkner, Columbia Axle Co., and Charles A. Dana, Spicer Manufacturing Company.

**Protecting Industry** In the war-torn world of today America must strengthen her internal and external fortifications if she is to survive the menace of totalitarianism. The protection of our industrial facilities to insure the uninterrupted production of goods and material is essential to our national defense. Based upon this premise the FBI in September of 1939, in accordance with the request of the War and Navy Departments, inaugurated a program to survey the protective facilities of manufacturing establishments having large contracts to provide the government with defense materials. The purpose of the surveys is to submit recommendations to bolster the physical protective facilities of the manufacturing plants for the prevention of sabotage and espionage activities.

The first and final responsibility to give speed and strength to our national defense program by protection against espionage and sabotage lies with industry itself. Only through the energy and alertness of its officials and workers will the full measure of preparedness be attained.

In line with this plant survey program and to assist industrial concerns and municipalities in establishing effective protection against possibilities of acts of espionage and sabotage the FBI prepared a comprehensive booklet entitled "Suggestions for Protection of Industrial Facilities." Because of its confidential nature this booklet is limited in distribution to heads and duly constituted law enforcement agencies and executive officials of industrial concerns manufacturing defense materials under government contracts.

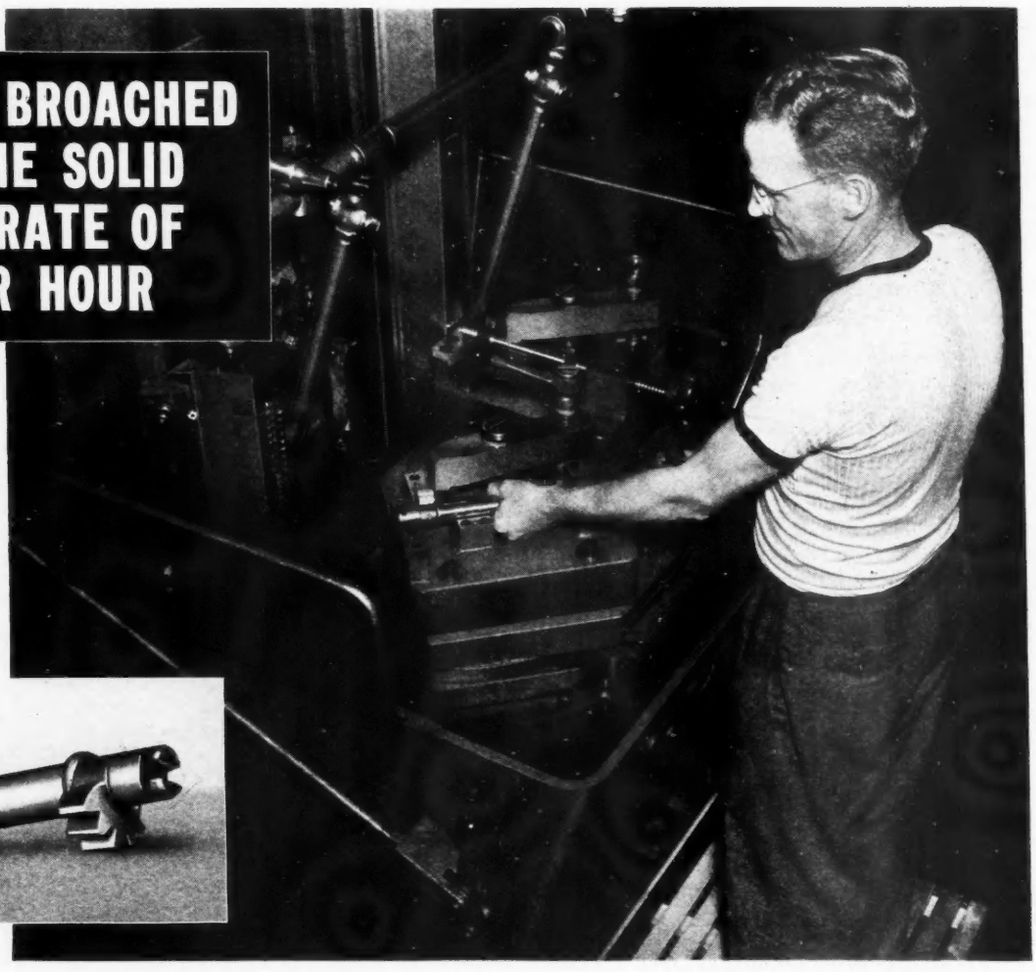
In response to the many questions as to how to obtain this publication I wish to state that a copy will be furnished an industrial concern upon the written request of an executive official.

Sincerely yours,

JOHN EDGAR HOOVER,

Director, Federal Bureau of Investigation.

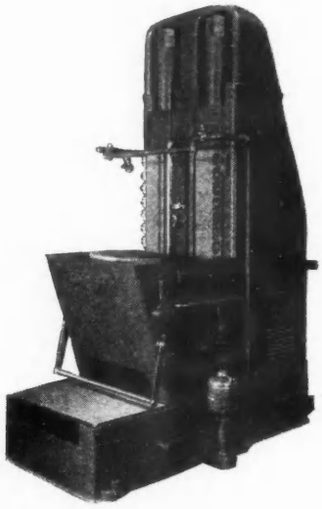
# TEE-SLOTS BROACHED FROM THE SOLID AT THE RATE OF 183 PER HOUR





TEE-SLOTTING has always been an expensive machining operation, both from the point of slow production and consumable cutter cost. Now, reasonable lengths of tee-slots can be *broached*, and at exceptional savings.

*In the illustration above, a CINCINNATI No. 5/54 Duplex Vertical Hydro Broach Machine broaches tee-slots, from the solid, in the ends of pitman shaft gears. In the right hand fixture the slot is roughed out to depth, and then finished at the T-section and to width in the left hand fixture. Production averages 183 parts per hour.*



Perhaps many of those high cost parts in your own shop could be machined more economically and accurately on a CINCINNATI Broaching Machine. Our engineers will be glad to give you their recommendations, based upon their experience in milling and broaching. In the meantime, write for literature—catalog M-886 for the Single Ram machines and catalog M-894 for the Duplex machines.

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AUTOMOTIVE INDUSTRIES

Published on the 1st and 15th of the month

Vol. 83, No. 11
December 1, 1940

# Synthetic Hay for Our War Horses

## *What kind of "fodder" do mechanized animals need, and do we have enough of it in case of a national emergency*

By ROBERT E. WILSON*

TO AN extent unparalleled in history, the conflagration we are watching is a war fought *with* petroleum and *for* petroleum. Germany's mechanized invasions could never have been undertaken had that nation not previously developed its synthetic processes and built its tremendous plants for making gasoline from lignite. Much of the output of these plants had been hoarded for several years to build up large reserves.

The gasoline consumption of the German army in the few weeks of its drive through the low countries and into France is estimated to have been greater than its consumption during the entire four years of the last World War. Its mechanized equipment was as hungry for gasoline as cavalry ever could have been for hay and, like cavalry, the speed of its advance enabled it to live off the country to a very considerable extent. Both the strategy and the tactics of the war as carried on by the Axis powers have been increasingly dictated by their urgent need to augment their petroleum supplies by every possible means.

Germany's shortage of gasoline and her seizure of all available stocks in the occupied countries have had an effect on civilian life and activity which is almost inconceivable to Americans. Civilian consumption of gasoline practically has ceased. In the streets of occupied France and the low countries, a gasoline-driven vehicle is a rarity, unless it is in the service of the German army (or the Gestapo!). Bicycles, a few horse-drawn vehicles and cars equipped with gas producers, are about the only vehicles that appear on the almost deserted streets. The principal business of some of the automobile companies in France and Belgium is making small trailers carrying equipment to generate gas from charcoal, with which passenger cars are able to operate with fair success.

All this speaks louder than words as to the widespread effects of the shortage of petroleum among the Axis powers. Lubricating oil for industrial machinery is also an acute problem, and animal and vegetable oils have had to be pressed into service, with frequently unsatisfactory results. Oil taken from the crankcases of German planes is reported to have been used far beyond what we would consider safe practice.

On the other side of the picture, Britain's magnificent resistance to what seemed overwhelming odds in the number of planes has been made possible, to no small extent, by Britain's superiority in both the quantity and the quality of her aviation gasoline. Germany appears to have little better than 87 - octane gasoline, usually containing excessive quantities of lead, whereas Britain has the benefit of synthetic gasoline of 100 octane number or slightly better. This apparently small difference fails to indicate the outstanding military value of our new superfuels.

*Robert E. Wilson*

### *Our Program of Mechanization*

All are generally familiar with the rapidly expanding program of our

* Petroleum Section, Raw Materials Division, Advisory Commission to the Council of National Defense, Washington. Condensed from an address by Dr. Wilson at the 21st Annual Meeting of the American Petroleum Institute.

navy, culminating in a real two-ocean navy of unmatched fighting power—all dependent upon heavy fuel oil as its driving force. The spectacular development now under way for our air services is also well known, and all new fighting planes are designed to take advantage of synthetic superfuels never dreamed of a few years ago. Military plant production in this country is now close to 1000 units per month, and this will be more than doubled within a year and trebled in about 18 months. Of course, this by no means represents all the present or future plane-building capacity of our nation.

Less fully appreciated is the tremendous program being undertaken looking toward the mechanization of our land forces. Although our rather late start in this direction has its disadvantages, it has permitted us to take advantage of the most recent technical developments and the latest experience from abroad. Once our tremendous mass-production facilities can be brought into action, we shall be building a quality and quantity of tanks, trucks, and armored cars which will amaze the world. If land defense of this country should ever become necessary, this equipment, using our unequalled system of highways and our widespread and efficient gasoline-distributing system, will give this country a flexible defense system better than several Maginot lines. Just as one great advantage of the cavalry was its ability to live off the country, so the maze of distribution facilities, bulk plants, and filling stations of our peace-time industry will help to supply our mechanical horses with the hay they need, especially insofar as the military equipment is designed to utilize the fuels which are generally available.

To quote from a recent speech by Assistant Secretary of War Patterson —"All animal-drawn transportation is being replaced so far as practicable with motorized equipment. This does not mean that the death knell of the horse has been sounded, or of the army mule either. But of the 27 divisions in the continental United States, 25 now rely entirely on motor transport for tactical operation and supply. The field trains of our cavalry divisions have been motorized. And as a final indignity to the horse, our cavalry reconnaissance regiments are partially motorized and are equipped with motor trailers for the transportation of their horse elements.

"One hundred and eighty-six thousand vehicles will be required to carry out our motorization policy. Of these, 16,000 have been purchased from 1940 funds, and 39,000 will be delivered before January 15. Funds for the remainder are already appropriated or are before Congress."

### *Effect on the Petroleum Industry*

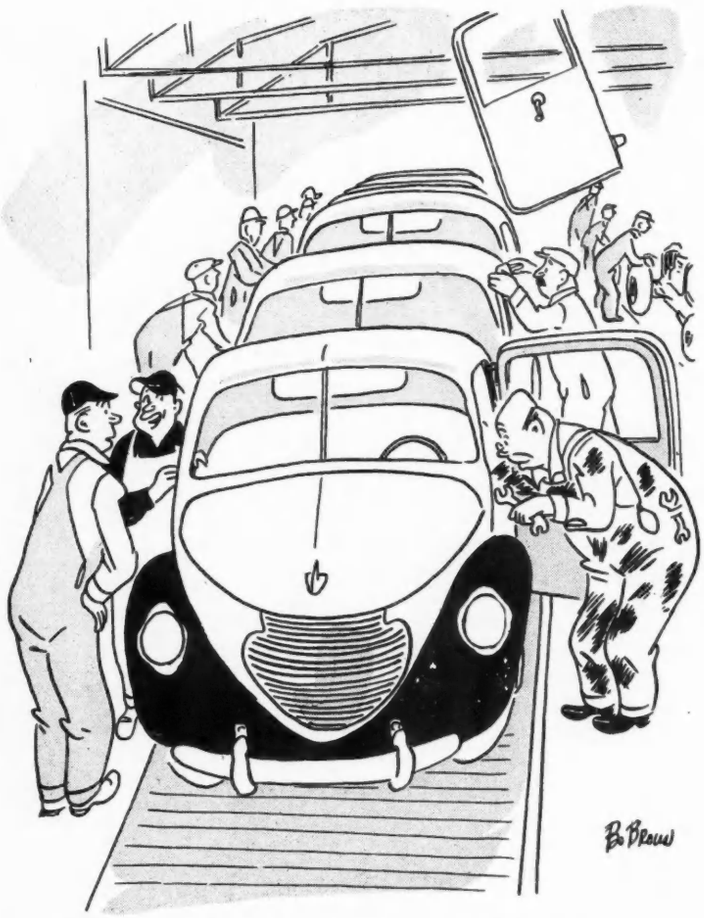
With so many industries running at capacity, adding extra shifts, and building new plants, it may seem surprising that the petroleum industry has not felt the upward surge. However, a little thought should make the answer clear. Our first task must be to make the machine tools and construct the needed buildings. Then we can assemble the organization and start mass-production operations to build the equipment. Only after this long and complicated process is well along in the second stage, does the defense demand for gasoline and lubricating oils really begin to make itself felt.

To date, the total buying of petroleum resulting from the defense program has been negligible—much less than enough to offset the loss of our exports to the continent of Europe. However, this demand is on its way. Not only will the army and navy have steadily increasing demands for almost every petroleum product, but there will also be additional industrial demands and demands from men who will have employment for the first time in many years. I estimate that by this coming spring these increasing demands will, on the whole, offset our loss of exports, and thereafter will increase steadily to a figure substantially beyond any total requirements the industry has yet seen.

Thanks to proration, the producing

(*Turn to page* 577)

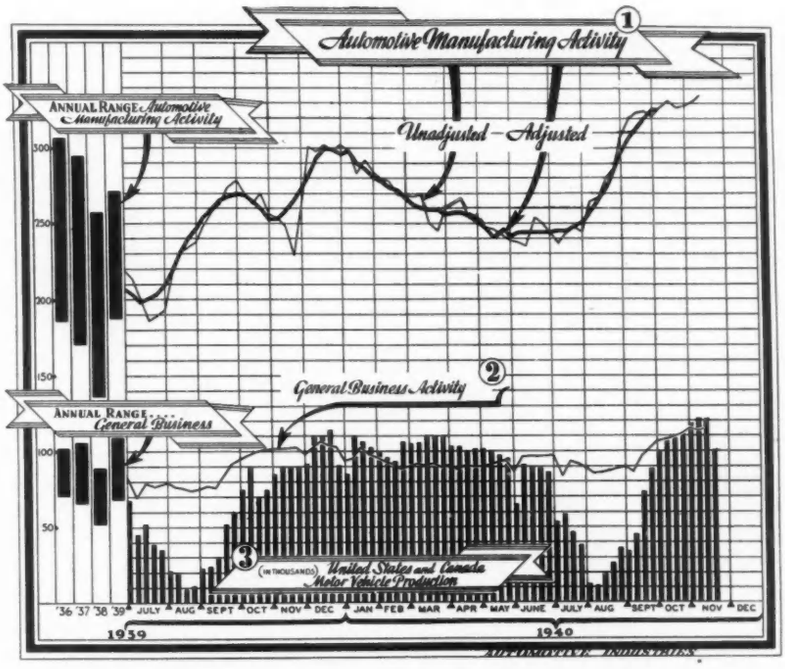
***The Brass-Hat Rack***




***The boss is afraid he might be called for compulsory military training if he doesn't get into essential work!***

# BUSINESS IN BRIEF

*Our own view of automotive production and sales; authoritative interpretation of general conditions*




***Weekly indexes of automotive general business charted***

# New November Record Set by the Industry

PASSING the 4,000,000 mark for the eighth year in the industry's history, automobile production set a new November record with an estimated output of 485,000 motor cars and trucks during the month. The 4,000,000th production unit for 1940 came off the assembly line during the third week of November. Although the Thanksgiving holiday cut November to 20 working days compared to 23 for October, the month's production was only approximately 35,000 units less than for the previous month. Several producers, notably Pontiac and Buick, upped their output by working Saturday shifts in an effort to cut down the steadily mounting unfilled order bank.

Production for the week ending November 23 was estimated at 100,500 units despite the fact that the Thanksgiving holiday cut a day off the work week at most plants. It was expected to climb back to 121,000 units for the succeeding week, equalling the year's highest production figure for a single week.

General Motors turned out 42,200 vehicles for the week ending Nov. 23, while Chrysler accounted for 22,500 and Ford assembled 21,600 units. Studebaker headed the independents, followed by Nash, Hudson, Packard and Willys. Buick, Pontiac, Cadillac and Nash all have boosted their fourth-quarter production schedules over original estimates.

[1] 1923 average = 100; [2] Prepared by Administrative and Research Corp. New York. 1926 = 100; [3] Estimated at the Detroit office of AUTOMOTIVE INDUSTRIES.

November's estimated production of 485,000 units exceeded the best previous November, 1935, by a wide margin. Output in the latter month was 408,550 units. This followed a record-breaking October which saw 514,374 vehicles manufactured, according to Department of Commerce figures.

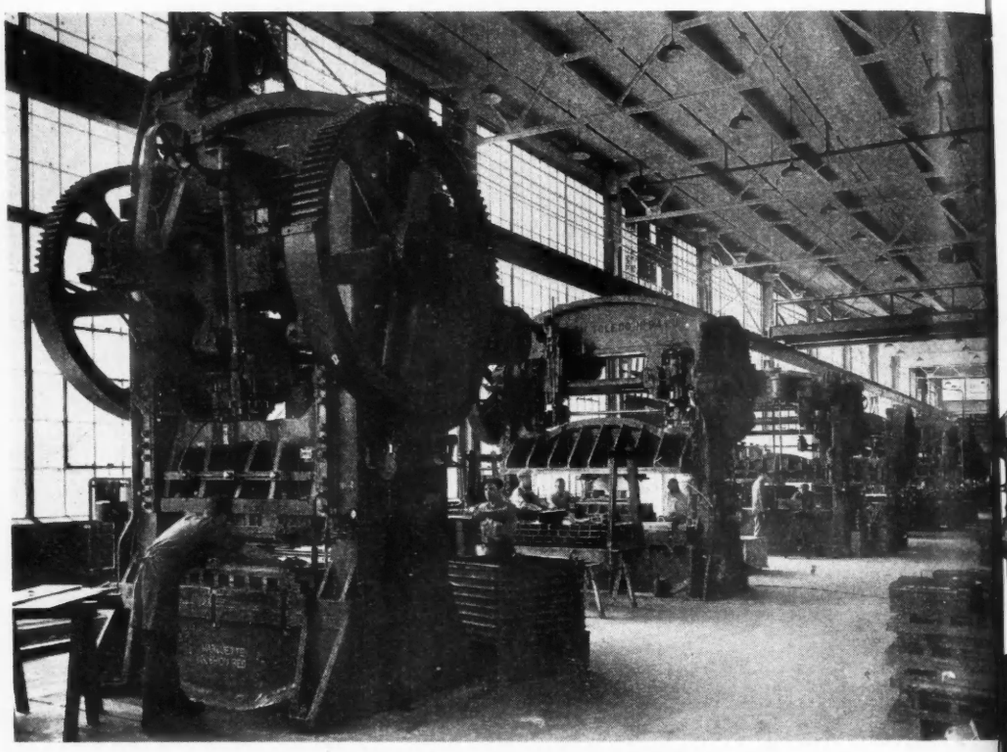
The high production rate has been maintained for a longer period than anticipated because retail sales have remained at a consistently high level. Increased cash available with consumers due to National Defense spending and the expectation by some buyers that rearmament work may affect new model production next spring are credited with stimulating retail deliveries. October retail deliveries of 380,182 passenger cars and trucks, according to AMA records, were the greatest for that month in the industry's history. They were 37 per cent greater than October, 1939, with 326,219 passenger cars and 53,963 trucks delivered to consumers. General Motors retail sales in October showed a 68 per cent gain over the previous year. All five General Motors divisions established new October records, while Studebaker had the best selling month since July, 1928.

Sales gains for the first 10 days of November were not so spectacular, although Pontiac and Oldsmobile showed gains of 22 and 16 per cent, respectively. Used car sales also were good, indicating there would be no likely glut in the second-hand market.

# Fruehauf Custom Bodies

By JOSEPH GESCHELIN

ONE OF the most striking examples of pioneering in commercial vehicle manufacture has been given expression by the Fruehauf Trailer Co., with the recent introduction of mass production methods and straight-through mechanized assembly procedures in the fabrication of Fruehauf trailers. Needless to say, this result has been achieved by a conscious correlation of advanced engineering design with the latest available production techniques.



*Here is a perspective view of the fine press line in the body shop, the Clearing press, at the head being just out of the range of the camera at the left. The first press in this view is a Toledo press with a Marquette cushion bed.*

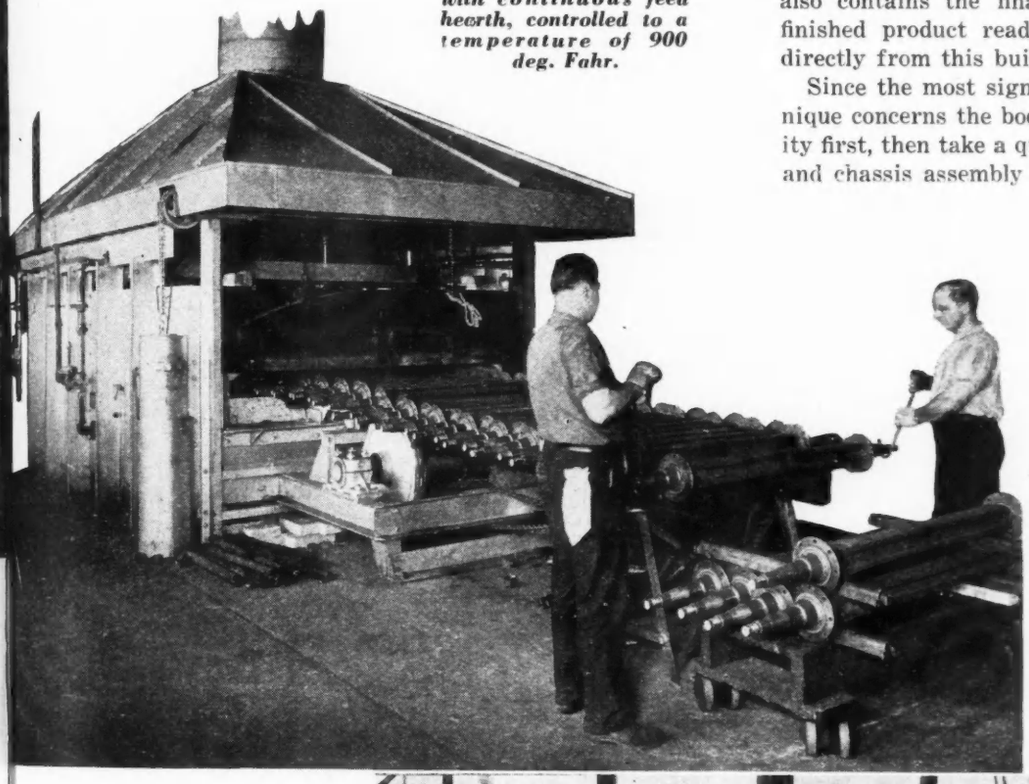
Looking at the sales record, it is obvious that the widespread acceptance of the current line of trailer equipment strained the available facilities of the Detroit plant and made it necessary to embark upon a major expansion program, culminating in the erection of the new body shop—Plant 2—across the street, north of Harper, coupled with a complete realignment of the productive floor space in the original building.

Today, all body building—the conventional corrugated type, the new Aerovan, and the advanced stainless steel job, as well as all manner of specials, has been centralized in the new daylight body shop which boasts a floor space of 134,416 sq. ft. In the original plant, south of Harper, the machine shop, frame construction, and chassis assembly all have been rearranged and expanded within the 145,000 sq. ft. of floor space.

Viewing the operation in perspective, the general scheme of things is so coordinated as to have a flow of materials first through the machine shop, then to the sub-assembly stations about the final chassis line where the frames and running gear units come together for the final assembly operation. The enormous chassis are built on a huge mechanized conveyor line, quite similar to the process in a passenger car plant, then spray painted in a large spray booth which marks the end of this phase of the operations.

***This is the Fifty-fifth in the series of monthly production features***

# in Mass Production



*(Below) Salem furnace is used for normalizing the one-piece axles. This is a gas-fired unit with continuous feed hearth, controlled to a temperature of 900 deg. Fahr.*

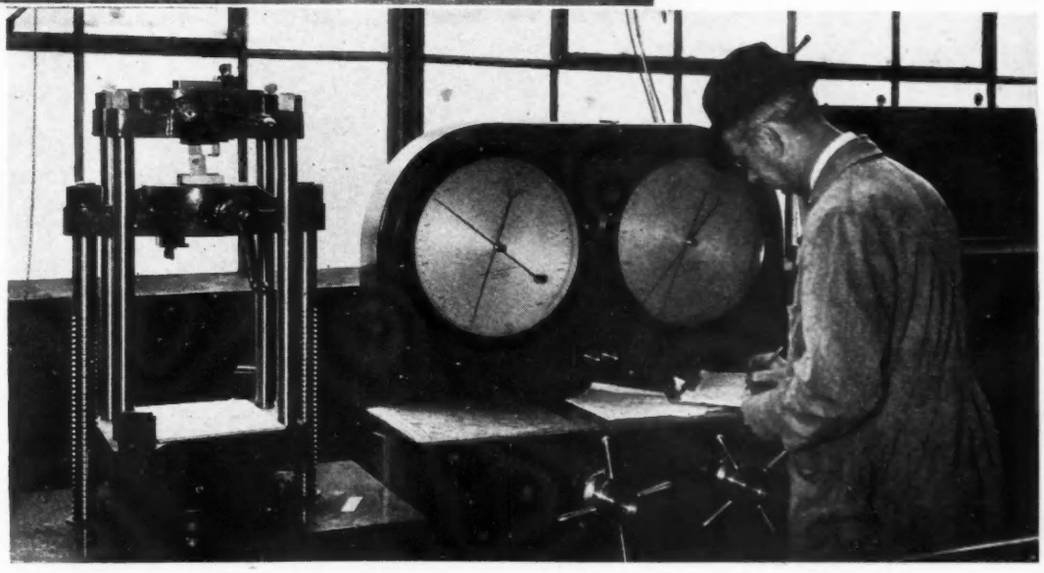
The chassis then are towed across the street to the body shop ready for assembly with the bodies. Not only does Plant 2 produce the body assemblies but it also contains the final inspection lines, so that the finished product ready for customer delivery clears directly from this building.

Since the most significant chapter of the new technique concerns the body shop, we shall trace its activity first, then take a quick glance at the machine shops and chassis assembly on the other side.

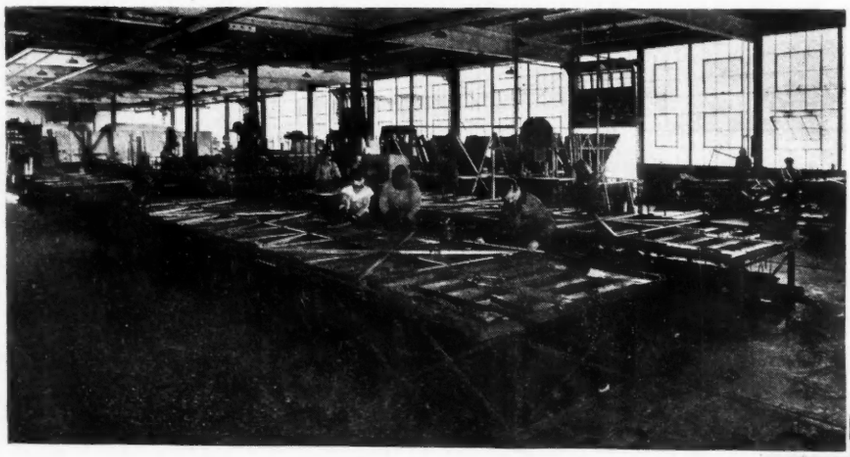
### Body Shop

Here the floor plan is arranged to expedite the smooth mechanized flow of operations for the erection and final assembly of bodies and frames for the basic line of Fruehauf trailers. The many special designs —tankers, warehouse bodies, etc.—also are handled here in a special section out of the path of the higher production jobs.

A bird's eye view of the floor plan scheme shows,

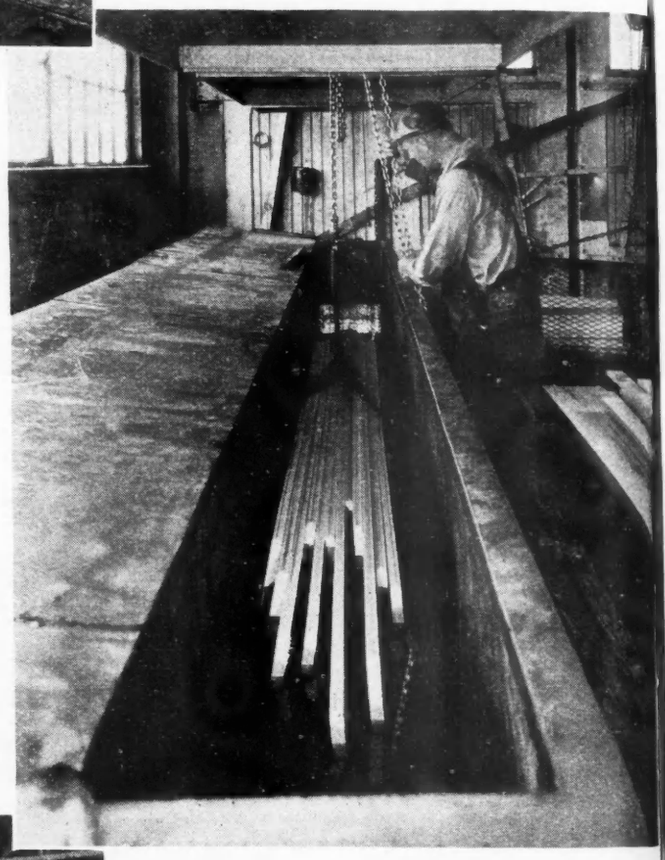


*(Right) Sample weld specimens are made on each of the two framing machines for each set up. These are pulled apart on the Tinius Olsen direct indicating testing machine, results recorded in a daily log. No work can be done unless the adjustment of control mechanism is approved by the foreman after proof testing.*



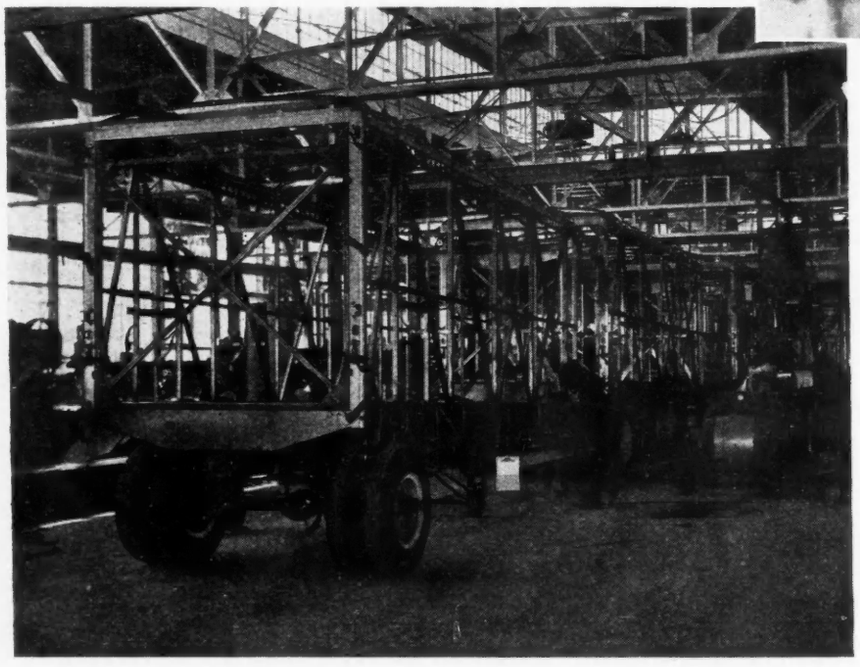
*(Left) Major sections of the standard trailer bodies are made up in this department, assembled by welding in the huge framing fixtures shown here.*

*(Below) All wood parts used in Fruehauf trailers are chemically treated in this vat to provide resistance to humidity, fungus, and termites.*



first, a fine press shop bay extending along one side of the building. At the head of the line is a large streamlined, 500-ton Clearing press which is used for forming various types of frame cross-members, three Toledo presses, two Bliss presses, a Bertsch press, and a large power brake. Adjacent to this line is a department equipped with square shears, a Bliss shear, Niagara shear, Bertsch shear, several Federal spot welders, and miscellaneous machines of this character including an Elmes press with a long narrow bed, used for forming the long, deep bead in body and door panel sheet metal sections.

As the chassis enter the building ramp they are transported to about the center of the building at the extreme entrance end and enter the chassis welding booth which has a mechanized conveyor some 70 feet in length. Here the chassis is completed by attachment of fittings and special parts according to the specifications for each individual order and then is ready to start on the final assembly line, i. e., either the No. 1 or the No. 2 line, depending on the type of body.



Corrugated bodies are prepared for the final assembly line in a large bay at the entrance end. Here the corrugated sheets are welded, fitted with wood fillers, finally welded into the body form in a huge welding jig. Rear doors also are prepared in this bay. The corrugated bodies then meet the chasses on the No. 1 line ready for the final assembly

*(Left) Assembly of trailer bodies onto chassis in the new body shop. G. E. portable arc welding machines are employed in this operation.*

operations. The mechanized assembly lines are fitted with conveyors 215 ft. in length.

Another large bay along the wall opposite to the press bay is devoted to the fabrication of elements of the standard trailer body types. Here will be found huge welding jigs for making up in the major sections such as the sides, roof, ends, etc. In addition there is a large wood-working department with equipment for making the various wood parts used in these bodies. As this is a real high-production set-up, there are two of the big body framing jigs for body assembly prior to scheduling for the final assembly line. The framed bodies, after completion, are transported by overhead hoist to assembly line No. 2 where they meet the prepared chasses according to sales schedules.

Immediately adjacent to this department, along the extreme wall side, is the department for fabricating the latest addition to the Fruehauf line—the Shot-welded stainless steel trailer. As will be described later, the structure is assembled in two operations on two separate welding fixtures.

It may be noted at this juncture that the No. 1 and No. 2 assembly lines are made in two long sections. The corrugated bodies are taken off the first section of the No. 1 line, shifted to the aisle at the right, moved to the other end of the building for paint and final inspection. The standard jobs proceed right through the second section of the No. 2 line.

Stainless steel bodies enter the No. 1 line at the beginning of the second section for the finishing operations. These lines have a conveyor 283 ft. in length.

Following along the wall, the next bay after the stainless steel body section is the door department where the doors are finished, fitted with hardware, made ready for delivery to the assembly line. Beyond this is the last bay in the extreme end corner where the many special body types are erected.

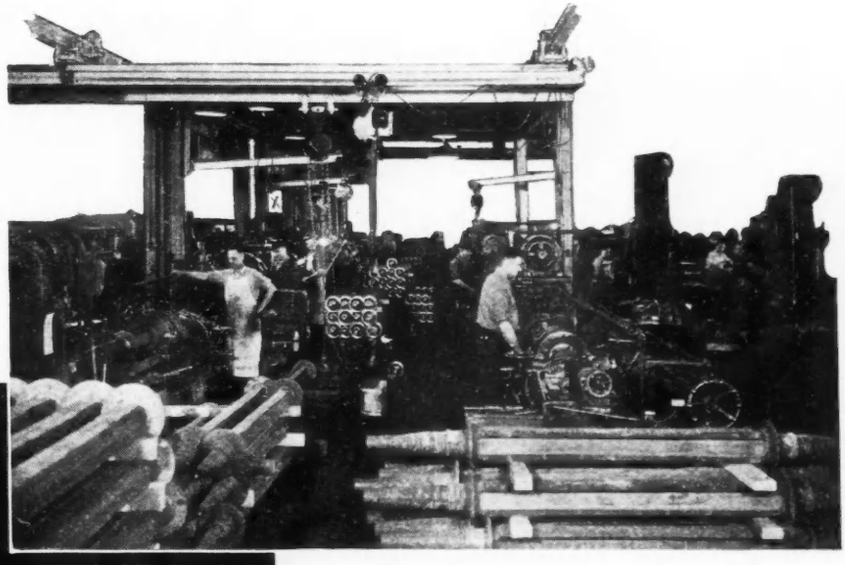
At the end of the second section of the assembly line, the standard and corrugated bodies move into a large canopy paint spray booth, then through a drying oven 150 ft. in length. Special paint specifications are handled in a smaller down draft ventilated spray booth served by its own drying oven.

After completion of the paint job on all types, also including the stainless steel bodies which take no finish over the metal, the finished trailers move onto the final inspection line, served by a mechanized conveyor 280 ft. in length.

On this line they receive the finishing touches, repairs, special striping, lettering, etc., and are ready for delivery from the spacious yard.

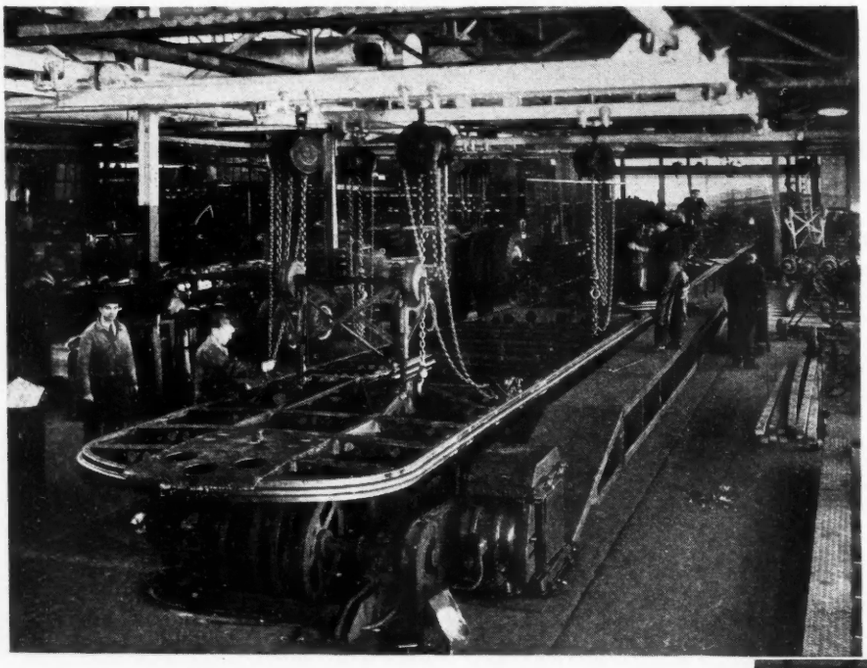
Reverting for a moment to the assembly lines, it is of interest to mention that each of the lines has a section with a scaffold platform on each side of the body, permitting work on the sides and roof of each body. These sections of the line are served by a High-cycle tool duct supplying power to the many specialized portable tools required by the operators.

Throughout the body shop, use is made of the latest types of welding equipment in the fabrication of



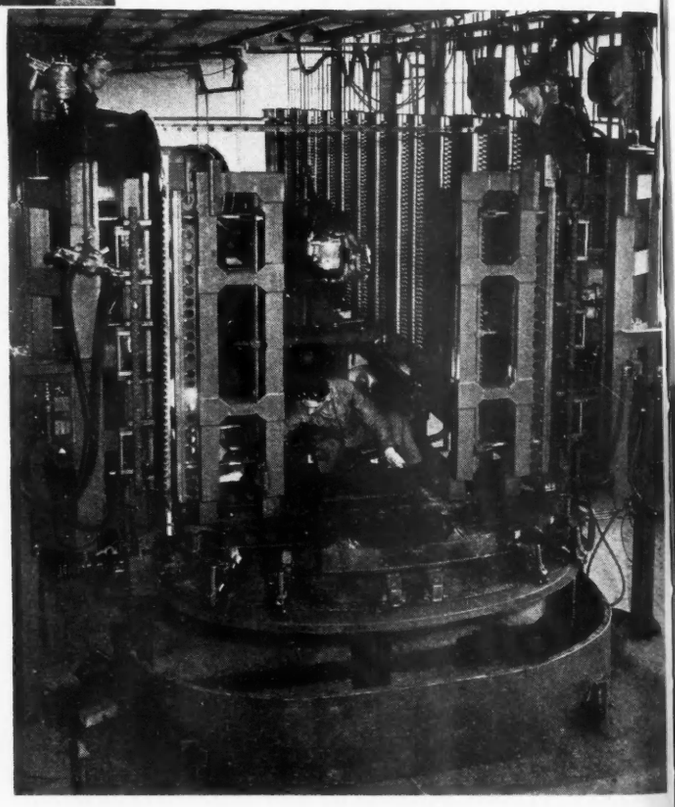
*A general view of the large bay set apart for machining Fruehauf axles.*

***(Left) Close-up of work station of the new Colonial Utility surface broaching machine recently installed in the machine shop. One of the most flexible set-ups to be found in the industry, the machine handles the broaching of 34 different parts, using seven different sets of tools. The work in the machine is an eccentric anchor pin bracket on which two surfaces are being finished in one pass.***



*(Left) Looking down the chassis assembly with a clear view of the sub-assembly stations on both sides. This is a heavy-duty conveyorized line, served by overhead hoists for handling component units.*

*(Below) First framing operation on Budd stainless steel body, lining up the sides with precision jigs in the massive framing fixture.*



the standard and corrugated bodies and chassis operations. These include Progressive portable resistance welding guns, Hobart electric arc welding machines. Electrical equipment for the stainless steel bodies is of special nature to be described later.

Of interest to production men as well as the buyers of Fruehauf trailers, is the fact that all wood parts are given a special chemical preservative treatment by immersion in a large tank containing the chemical solution. This affords the much-needed protection against the effects of adverse weather conditions, extreme humidity, fungus, termites, etc.

The stainless steel body department, naturally, is unique in the industry. The complete major sections of the body structure—right and left side panels, roof panel, and front end section—are received from Budd in pre-fabricated condition, ready for assembly. All of the sections are proof-welded by Shotwelding in the Budd plant in Philadelphia. These parts come in from the railroad siding directly at the first framing fixture. The sections are carefully fitted in the massive steel fixture, aligned by means of hydraulic jacks at each end, then joined into an integral structure by Shotwelding.

The first fixture is served by a battery of five G.E. Thyratron welding control and automatic weld recording machines. These cabinets control the operation of a battery of portable welding guns, and one large booster unit. The transformers for the welding guns are made by General Electric.

Upon completion of the first welding operation, the body frame is lifted by hoist and transported to the second welding fixture where the integral floor and chassis structure is assembled. This operation includes the integral assembly of the stainless steel undercarriage assembly, which becomes a part of the floor. This assembly machine has three of the G.E. control cabinets mentioned above, serving a battery of five welding guns operated with G.E. transformers.

Although the G.E. control is designed to provide guaranteed proof welds, still another precaution is taken to assure perfection of the welding operation. This takes the form of a special Tinius Olsen, indicating type tension testing machine, installed along the wall between the two welding fixtures. One of the functions of the foreman of the department is to check the operation of the welding equipment by making a sample weld specimen for each body that goes through the welding machine. The specimen is tested to failure in the Olsen machine and the reading of

maximum load recorded on a daily log. The welding operation is not permitted to start unless the test specimen pulls within the specified limits.

### *Machine Shop*

The plant on the south side of Harper has been completely rearranged to accommodate the modernized and expanded facilities for machining, for frame construction, for chassis assembly.

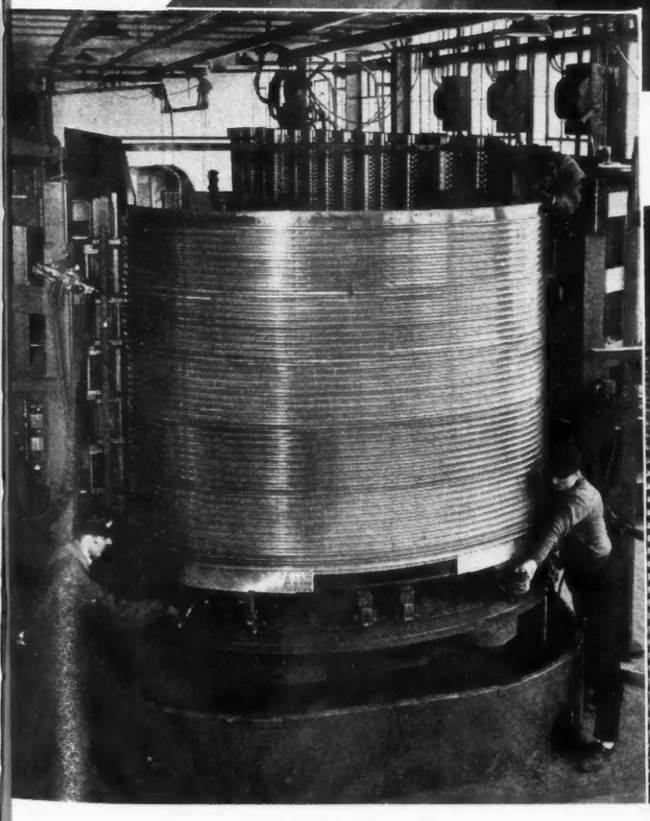
Generally speaking, the machine shop handles a wide variety of parts machining including brake shoes, brake cams, brake drums, a number of special forgings, and the one-piece axle.

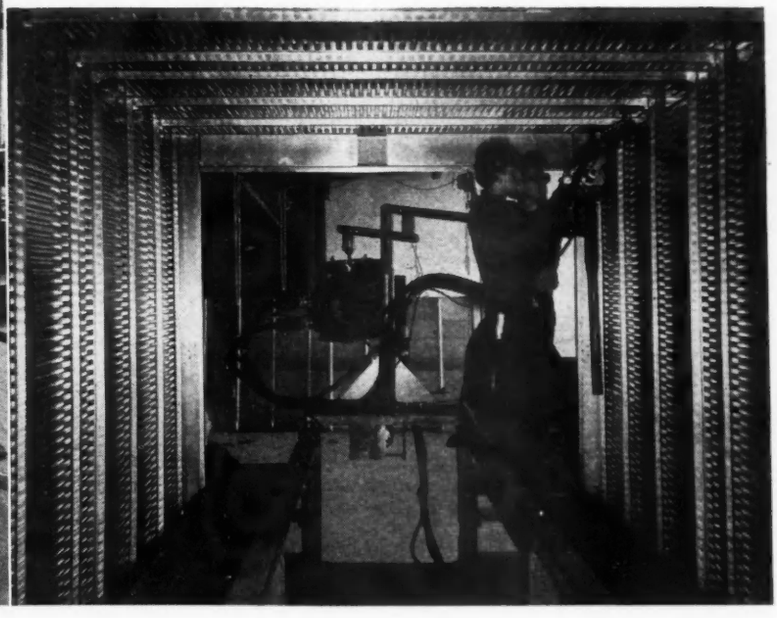
Some idea of the modernization program may be gained from an examination of two interesting items of equipment which were installed about the time this article went to press. The first of these is a big Colonial Utility press of 15 tons capacity, designed to handle a variety of surface broaching operations on a group of 34 different parts. This is a single-ram machine with a 36-in. stroke. The machine has been provided with ten or more special fixtures, each one intended for a specific surface broaching job, some fixtures capable of handling several different parts without change in set-up, and seven sets of broaching tools.

Here is an outstanding example of the application of a flexible general purpose machine for multiple-lot production. In effect, the one machine with its complement of special fixtures and tools will take care of the majority of parts previously routed over a number of milling machines.

Another of the fiexible unit-type machines installed here is a special multiple-head drilling and tapping machine, built by the LeMaire Tool & Mfg. Co. With this single machine Fruehauf will handle the drilling and tapping operations on the fifth wheels, thus coordinating the many operations previously performed on various single-spindle drill presses.

One of the most important of the machine shop operations is that of finishing axles. The axles are heat-treated, and after machining they are normalized in a continuous feed hearth normalizing furnace supplied by the Salem Engineer-

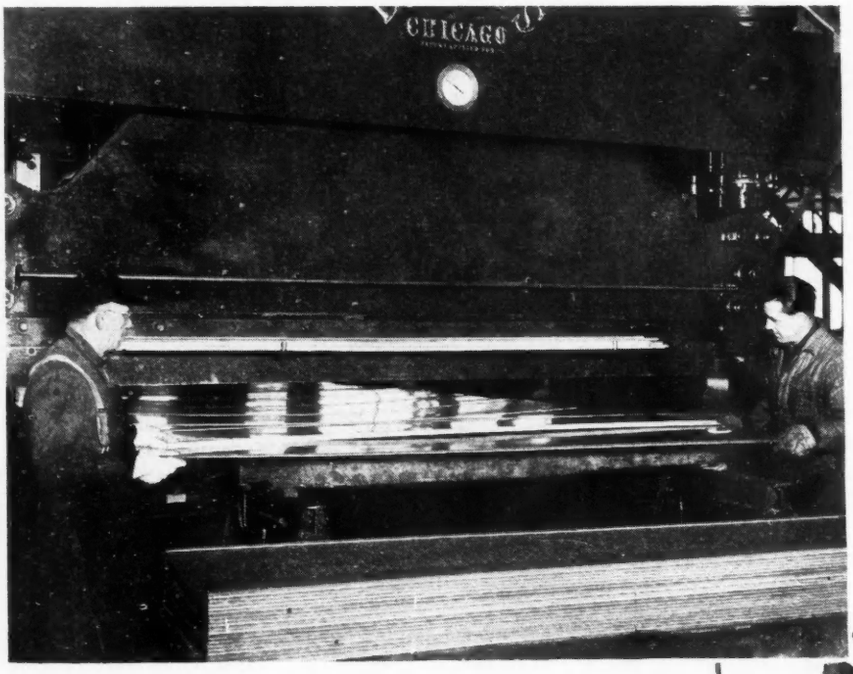




***(Left) Roof section of stainless steel body is held on both sides with a series of powerful clamps, as shown, during the welding operation. One of the Progressive gun welders is in operation at the right.***

***(Below at left) Lining up the front end section in the framing fixture for stainless steel bodies.***

***(Below) These operators are making the welds on the inside of the stainless steel body, using a Progressive gun welder. The portable transformer may be seen close by.***

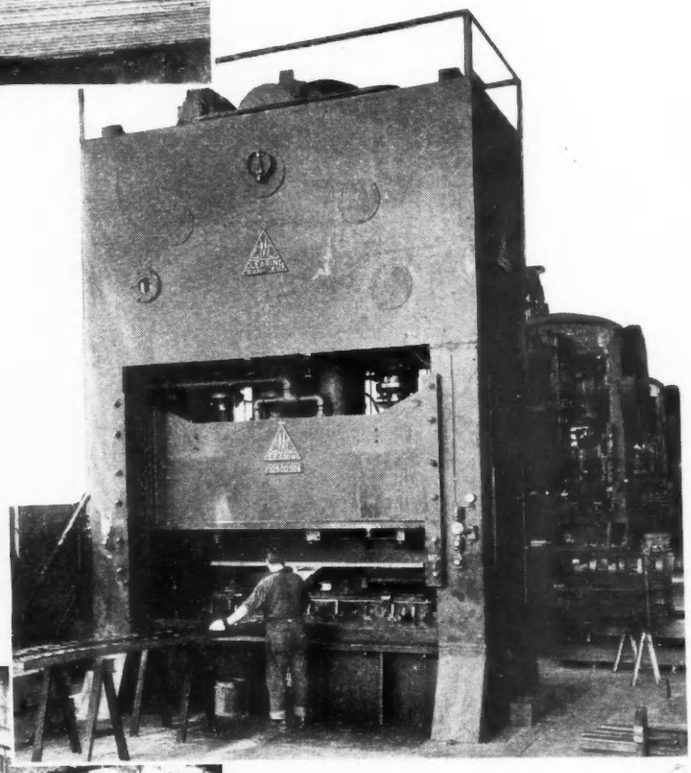


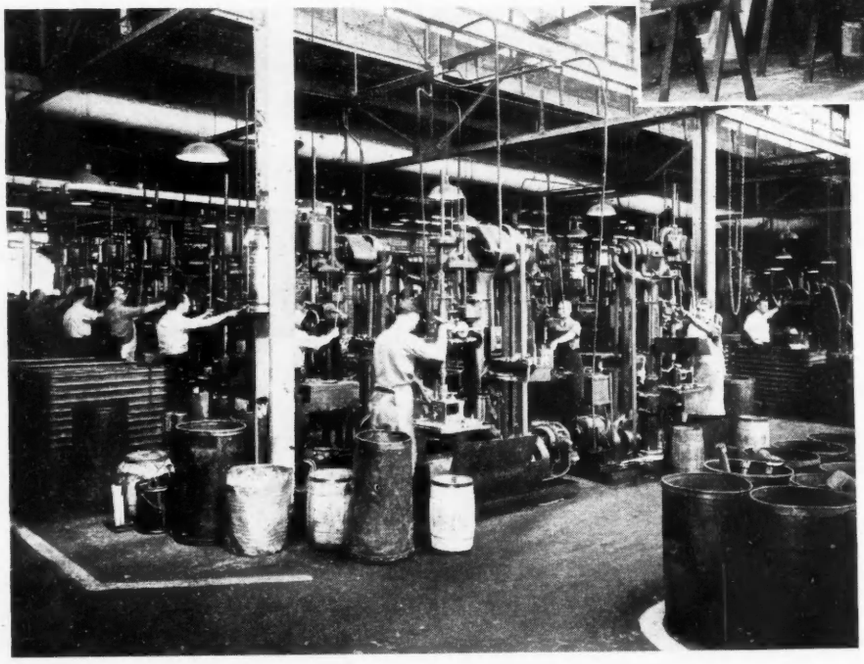

Fabricated frames and assembled units meet at the chassis assembly line for the final assembly operations. Interesting feature of the assembly line is the fact that it consists of an extra heavy-duty mechanized conveyor, providing the same character of efficiency and facility that may be found in a passenger car plant or in one of the modern truck assembly plants.

Completed assemblies go through a paint spray booth after coming off the conveyor, then are wheeled over to the body shop across the street.

ing Co. It is gas-fired with an automatically controlled temperature which is held precisely around 900 deg. Fahr.

The primary operations for building trailers begin with the frame assembly which originates in a large department at the extreme end of the building. There are two lines for this purpose, the principal line for large volume or standard frames, and an auxiliary line for special frames of every description. The main line has massive jigs to facilitate frame assembly and is served by a battery of Hobart electric arc welding machines. In addition, the line has a number of Progressive portable gun welders.





*(Above) This huge streamlined Clearing crankless press, used for forming various frame members for the standard line of trailer chasses, is at the head of the new press line in the body shop.*

*(Top of page) This is a close-up of the Elmes press, a long narrow bed machine, used for forming the deep bead in door and panel sheets.*

*(Left) General view of a section of the machine shop, showing the general character of the equipment employed here.*

# Synthetic Hay for Our War Horses

(*Continued from page* 568)

branch of the petroleum industry is particularly well prepared for any emergency.

Today those states which have practiced sound conservation principles have built up tremendous underground reserves, available at a moment's notice for practically any emergency—and this without putting an extra load on the steel industry or the labor market to drill thousands of new wells. You may well guess that anyone locating new refineries or industries based on petroleum would naturally favor such states over those which have squandered their assets and have only a declining production to look forward to.

Of course, the industry must not relax its normal activity toward making new discoveries, although it should avoid unnecessary drilling and unsound spacing programs which use up capital, labor, and steel to no useful purpose. New wells and fields must be discovered and connected up, and new pipe lines built, as old fields play out. In spite of alarmist reports in various quarters, our industry is still a long way from becoming a static one, coasting along to ultimate depletion.

### Refining

In refining the possibilities of immediate expansion of output to meet sharp increases of demand is not as great as in production; but, nevertheless, our civilian demand is so large that it still dwarfs every possible military demand except that for a few special products. Few, even in the industry, realize that the increase in our gasoline production is more than twelvefold since 1915. Our shutdown refinery capacity today is greater and more efficient than our entire capacity in 1917. It would be possible, by rather moderate methods of reducing civilian consumption, to meet all military demands without any increase in refinery capacity, so that there seems to be no justification for asking the Government to finance new refining capacity, as many seem to anticipate. However, I am sure the petroleum industry would not consider that it had done its duty by its country and its customers if this had to happen. When in cities like Chicago and St. Louis from 40 to 55 per cent of the individuals entering the central zone of the city do so by means of gasoline, we cannot lightly talk of curtailing civilian consumption, as though it could be done as easily as in Europe. If we are to avoid such a possibility, we must at least keep our refineries growing fast enough to keep pace with the growth of peacetime consumption and keep customary reserve of around 20 per cent of shutdown capacity available for possible wartime expansion. As new and more efficient refining equipment is developed and installed, the old should, so far as possible, be held in reserve for emergencies.

### 100-Octane Aviation Gasoline

The most probable bottleneck in our meeting the army and navy demands is also one of the most romantic stories of our industry, viz., synthetic 100-octane gasoline. Although the advantage of high-octane gasoline in making possible higher-compression engines has long been understood, the appreciation of its tremendous value for aviation purposes is somewhat more recent. In aviation, the more efficient high-compression engines have three advantages —first, a smaller fuel load; second, a lighter engine per horsepower; and, third, less head resistance, due both to a smaller engine and a lower cooling load, because more heat is converted into work and less into heat to be rejected to the atmosphere. All of these mean higher speed and/or greater load-carrying ability, both of which are almost priceless for military purposes. For example, a difference of only 25 miles per hour in the top speed of two fighting planes gives the control of the attack or retreat to the faster plane.

Fortunately for the defense program, the petroleum industry, with its genius for overbuilding, has already installed synthetic capacity beyond the present domestic and foreign demands, so there is today substantial excess capacity available for the building up of a reserve for possible war demand. The installed capacity is, however, barely enough to meet our probable peacetime requirements, including exports, once our advanced training program is well under way, and is substantially less than enough to meet present estimates of full wartime demand after our plane-building program is complete. Revised specifications have just been issued which should increase the quantity available without any adverse effect on performance. The importance of building a stock pile now, while we do have some surplus capacity, seems obvious, and a substantial start in this direction has recently been made by the army and navy. Even with such a stock pile, it would seem desirable from the defense viewpoint to have some additional capacity available within about 18 months, and I am hopeful that the industry will undertake such construction without Government aid if we are able to arrange to give such plants the benefit of the 5-year tax-amortization provisions.

### Lubricating-Oil Requirements

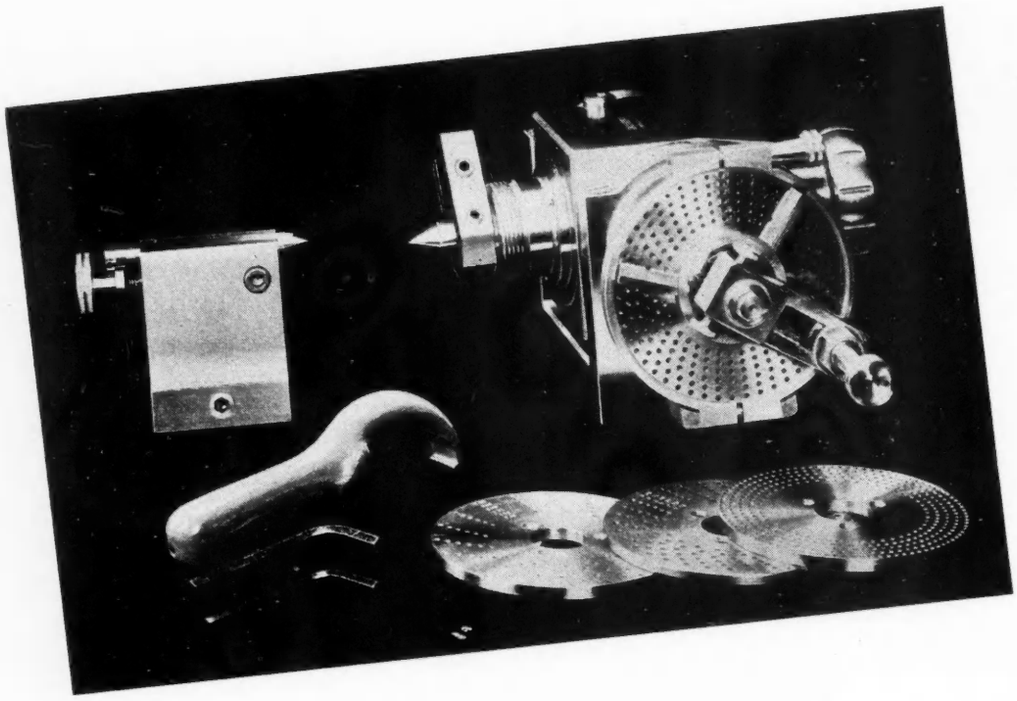
The lubricating-oil requirements of the aviation and the army mechanization programs will also be very substantial; however, insofar as we have been able to develop them, they will not be much greater than the export demand which has been lost. Apparently there will be no bottleneck problem, although we have called the attention of the army and navy to the fact that such products are today available at unprecedentedly low prices. Efforts are under way to reduce the number of different specifications for lubricants to simplify the problem of supplying the needs of the army in particular.

### Storage Problems

In order to be prepared to meet emergency demands at uncertain locations and to protect its customers from possible interruptions of transportation, it appears that the industry in general should increase its storage facilities, particularly along the eastern seaboard, and should count on carrying somewhat larger stocks in storage than would otherwise be considered adequate.

The adequate protection of such storage facilities from possible bombing attack is a matter that has given concern to both the Federal and state agencies. At our request, the American Petroleum Institute has appointed a number of regional committees to study this question and to confer with the army and navy representatives in the various areas, both from the standpoint of protecting the industry supplies and of protecting congested areas or harbors from the results of possible attacks.

A committee of seven expert terminal engineers, loaned by oil companies in different parts of the country, has been cooperating with the Petroleum Section and the army and navy in developing economical designs and desirable types of locations for the storage, by the two services, of reserve stocks of products such as aviation gasoline and fuel oil. It is anticipated most of such storage will be placed underground, particularly at the more exposed locations. Underground storage of much of the industry's stocks would not seem to be either feasible or necessary; but where new tankage is to be built in congested areas with high land values, the saving in area required, plus the greater safety and lower upkeep, should be carefully considered as offsets to the higher costs of buried storage.



*Index centers for Hardinge tool room milling machine.*

# MEN a

By H. E. BLANK, Jr.

WHEN John E. Lovely, newly elected president of the National Machine Tool Builders' Association and vice-president of the Jones & Lamson Machine Co., Springfield, Vt., addressed the recent annual meeting of this group in Chicago, he brought out some points pertinent to the role of the machine tool industry in the national defense program that seem especially worth passing along. The fact that the machine tool industry is ahead of most American industries with respect to expanded facilities and capacity for national defense production is attributed by Mr. Lovely to the deluge of foreign orders, chiefly from Britain, plus an early realization on the part of builders of machine tools of the importance of their products in the production of rifles, guns, tanks, aircraft, ships, motor vehicles and all sorts of instruments and equipment used in connection with these items. Within the past year the industry has expanded enormously its plants and equipment, increasing its output to more than double the rate of a year ago and over two and a half times the output of the peak year of 1929. The tremendous growth is even more impressive when expressed in dollars. Output of machine tools in this country expanded from $22,000,000 in 1932 to an estimated $400,000,000 in 1940. Total output in the peak year of 1929 reached $185,000,000.

The builders of machine tools have set an excellent example in demonstrating how effectively industry can cooperate with the government in promulgating the huge defense program. Several years ago a committee of top-flight representatives within the industry was appointed to work hand in hand with officials of the Army and Navy and other branches of government in problems of national defense. Mr. Lovely stated that the committee urged the government to put its arsenals and Navy Yards in good condition and to let educational orders that would permit industry in general to obtain actual experience with the problems involved so that they could swing promptly into the production of defense equipment should an emergency arise. A particularly noteworthy effort by the committee was its arrangement, made a full year ago, with the Ordnance Department to design single purpose shell machines which could be built outside the machine tool industry. The designs were completed last June and the first sample machine was completed in August. These designs, Mr. Lovely said, are now available to the Ordnance Department for the letting of contracts for such machines, so that they may be built outside of the machine tool industry if this proves desirable. The committee now has been expanded to 15 men and continues to cooperate closely and effectively with the government.

"In spite of the accomplishments to date," Mr. Lovely cautioned, "we nevertheless still have a mighty big job before us. As we increase the production of machine tools again next year, many serious problems will be encountered by many of our plants. The present output can and will be increased: a. by the additional use of existing plants and facilities; b. by farming out work to more sub-contractors, and; c. by the further expansion of some plants and the addition of still more equipment.

"We have encountered many serious problems in expanding our output in this past year. Many of our machine tool builders in their anxiety to do their part actually have expanded their plants and purchased added machine tools to increase their own capacity before they were sure that their purchases would be needed, before they knew what the rules of the game would be, before they knew what the rate of tax would be, and before they knew how they were going to pay for the added facilities they were acquiring.

"We know our industry is over-expanded already for

# and MACHINES

the normal peacetime business of the country and that, therefore, the expansions which have been made to take care of the defense program and the further expansions that may become necessary, should qualify for certification under the terms of amortization in the new tax bill.

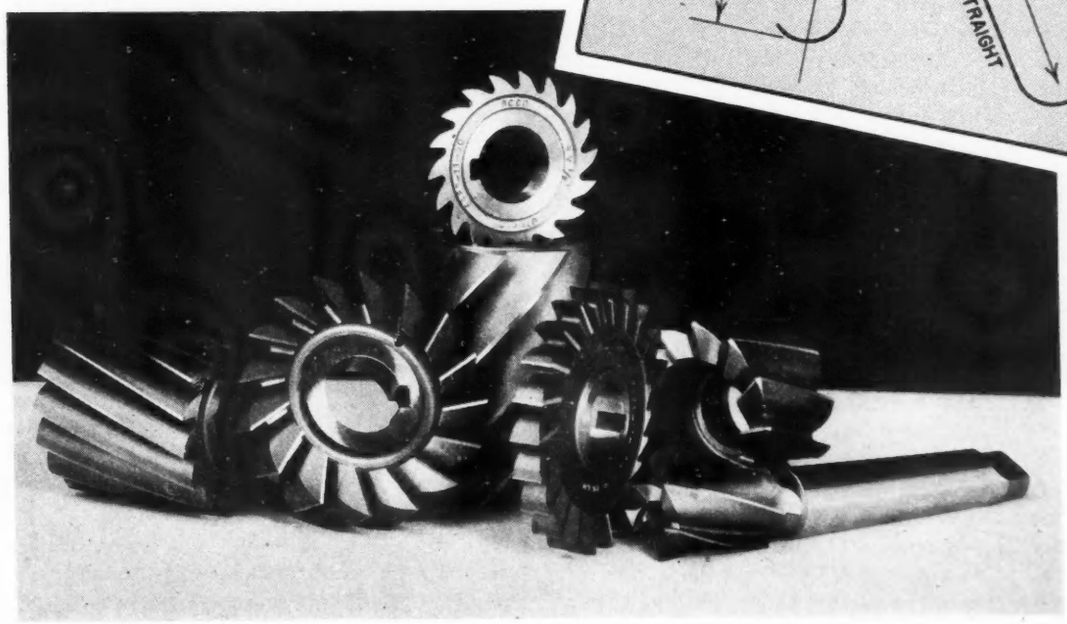
"Our plants must be maintained in liquid condition and kept in workable order. It is not only a fair thing, but a vital thing to our country in periods of emergency. The rush of work prevents operation at maximum efficiency. The forced training of new men and the necessity of using newly trained men results in a loss of time and spoilage of work if not kept in proper bounds.

"We do feel, therefore, that government must be sympathetic to business and that business must be treated in such a manner that it will survive this emergency rather than be sacrificed to the emergency.

"We want it definitely understood," Mr. Lovely concluded, "that insofar as the national defense program depends on the machine tool industry, we are resolved that we shall not be found lacking, and that as individuals, as companies or as an industry, we will find the means to furnish the machine tools that are needed."

HARDINGE BROTHERS, INC., Elmira, N. Y., is offering new index centers with its precision tool room milling machine. Design of the index centers incorporates sturdy construction, large collet capacity and operation features to speed up production in the milling of precision parts. Compact box-like construction minimizes the overall height to act as a sturdy base for the spindle section. The spindle is mounted in super-precision preloaded ball bearings and, with the same support for the machine spindle, make a combination to give a high degree of accuracy and rigidity for milling operations. The spindle nose is threaded 2 3/16 in. diameter—10 threads and interchanges nose attachments and collets with the machine spindle as well as with similar capacity Hardinge precision lathes. The spindle section swings through an arc of 220 deg. and is graduated in degrees for settings from 10 deg. below horizontal to 20 deg. beyond vertical. A vernier in minutes is incorporated for fine settings. The draw spindle is of two-piece construction to permit swinging the spindle through the arc of 220 deg.

The spindle is ground to take directly standard 5C Hardinge collets which have a range by fractions from 1/16 in. to 1 in. round, 7/8 in. hexagon or 23/32 in.




*Barber-Colman "Paraform" milling cutters. (Inset shows profile of cutter tooth)*

*Clark fork truck in action at tire storage department of Diamond T Motor Truck Co. plant.*

square. Precision hardened spiral bevel gears and a nitrided spiral bevel pinion, cut by Gleason, provide a four to one ratio between the spindle and the index plate crank. The four to one ratio is particularly advantageous in speeding up milling operations, being 10 times faster than the usual index head ratio of 40 to one and, at the same time, gives all of the usual divisions obtainable with the 40 to one ratio.

Four index plates are furnished, together with a chart listing all of the divisions obtainable from two to 360. The index plate mounting is independent of the gearing with the spindle and crank, being engaged between the two by means of the clamp on the outer periphery of the index plate. This means that work can be chucked and located as desired and the index plate adjusted accordingly—it does away with the usual practice of chucking and rechucking work until a location is found to suit the index plate which has the ordinary direct connection between the spindle and the work.

Anti-friction bearings are provided as a support for all gears and shafts. The spindle section has large swivel bearings and positive locks to secure angular settings. The spindle proper has a secure lock which is applied after an indexed position is completed. Adjustable positioning stops permit the going away from and accurately returning to an original angular setting which is often required in the chucking of duplicate work when the spindle is set on a vertical or near vertical plane.

The index head is arranged according to the modern trend for right hand mounting. Index head keys fitting the table are removable and the base of the index head has a cross key way to permit placing of the spindle parallel to the milling machine cutter spindle. The index head swings a seven-inch diameter. The index head and tailstock have a combined length of 14¾ in.

A similar index head is also offered for spiral milling and the rotary motion of the spindle is obtained through a set of change gears from the feed screw which is actuated by hand or power feed. This index head incorporates all of the features of the plain index head and is furnished with a chart covering all leads from 0.600 in. to 42.656 in.

The Hardinge tool-room milling machine, with which the new index centers are used, has a table size of 25 in. by six in. with a longitudinal travel of 13¼ in., transverse travel of 5½ in. and vertical travel of 13¼ in. The eight spindle speeds are from 110 r.p.m. to 1850 r.p.m. forward and reverse.

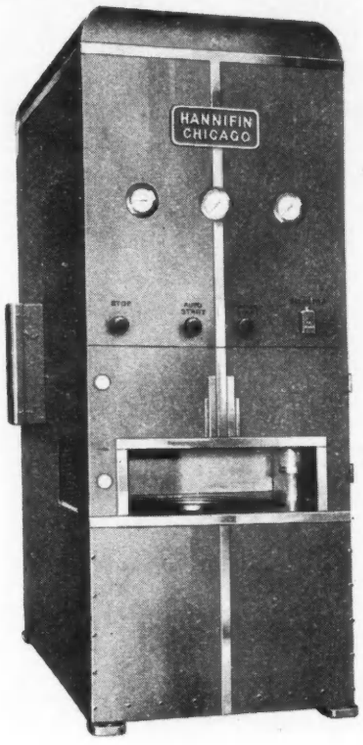
A CENTRIFUGAL quenching machine designed to provide accurate and controlled quenching of circular parts of all kinds is being manufactured by the Hannifin Mfg. Co., Chicago. Specific claims made for the equipment are: 1. correction of mechanical alignment, when hot, with adjustable pressures on fixtures to give flattening and rounding effect, as necessary; 2. controlled time of quenching operation; 3. controlled volume of quenching medium; controlled temperature of quenching medium as quenching progresses.

In operation, the heated part is placed on the lower fixture in the machine. This, and removal at the end of the automatic cycle of operation, is the only handling required. The holding fixtures (upper and lower) are designed to meet individual requirements of the part to be quenched. A mandrel for centering may be provided, and a certain amount of control of quenching action may be obtained when desirable, by suitable design of the fixtures. The holding fixtures are operated automatically, and in closing provide a mechanical straightening effect or alignment on the hot part.

The holding fixture is surrounded by a circular quenching chamber which opens in two parts with the fixture, and when closed provides a circular vessel for the quenching fluid. When closed the entire assembly of quenching chamber, holding fixture, and hot part, is rotated by means of a motor drive. The quenching fluid is introduced at the outer edge of the revolving container.

Oil is introduced in controlled volume and at uni-

*Dayton Rogers Mfg. Co.'s model "D" universal pneumatic die cushion.*




*Hannifin centrifugal quenching machine.*

form and accurately controlled temperature. The rotation, and the control of volume, produce a revolving "doughnut" of quenching oil around the circumference of the chamber. As volume is increased the hole in the doughnut is reduced, and the quenching action takes place from circumference of the part in toward the center. Oil flows out the revolving quenching chamber, under controlled conditions, so that uniformity of temperature is maintained by fresh oil.

Centrifugal quenching not only avoids distortion of circular parts, but allows control of the rate of quenching, and the degree of quenching. The operating cycle is automatically controlled, with uniform timing, and may be adjusted to furnish the desired timing for handling parts of various types. Sectional quenching under controlled conditions is easily obtained, allowing the center of the part to remain hot and unquenched, resulting in differential hardness of the finished part.

The complete cycle of automatic operation is remarkably fast, ranging from 40 to 60 sec. for representative examples of gear and sprocket quenching.

BARBER-COLMAN CO., Rockford, Ill., is manufacturing a line of milling cutters designated by the new name "Paraform." The company advances the following claims for these cutters: They produce more accurate work; 2. they produce better finishes on work; they produce more pieces per sharpening; they require less changing, which increases machine hours; they require less sharpening and have a longer life; they produce better results at lower cost per finished piece.

The sketch reproduced herewith (page 000) illustrates the basic principle of the profile of the Paraform tooth which is applied to all Barber-Colman cutters with but a few exceptions where special conditions require a different design, such as in formed milling cutters. It will be seen that the back of the tooth consists of two flat surfaces blended by a smooth, curved surface. The relief back of the land is straight in order to make possible a minimum width land as the cutter is sharpened, and at the same time maintain maximum strength at this important part of the cutter tooth. The flat surface on the back as the base of the tooth, combined with the curving blend between the two flats makes possible a combination of maximum chip space and maximum strength in the tooth. The rake on the face of the tooth is planned for best cutting qualities, and the curve at the root of the chip space is of such a radius as to prevent jamming of the chips between the teeth, permitting them to curl and flow out freely.

THE DAYTON ROGERS MFG. CO., Minneapolis, Minn., has announced a new model "D" improved universal pneumatic die cushion. The improved die cushions are now made in seven sizes, from six to 14 in., have drawing capacities for deep drawing work from two to eight in., and can be used with or without surge tank reservoirs.

Each cushion is supplied with a combination reducing regulating control valve and pressure gage. The die cushion may be mounted directly to the bottom side of the bolster plate, for all draw ring and pressure pad control operations, or they may be spaced away from the bolster plate, to any desired distance to allow blanks or slugs to pass through the punch press bolster plate.

Correct height of the pin pressure pad is predetermined and maintained by the hand-wheel, thereby compensating for bolster plate thickness variation, sharpening and grinding of dies, and the change of die design. The cylinder and piston is inverted on the section which serves as a pin pressure pad, making it possible to drop the pin pressure area to the maximum of the drawing stroke by releasing the air pressure and shutting off the supply so the pin plate stands out of the way for blanking and piercing operations, when not needed. The design of the cylinder section automatically shields the cushion proper so no pierced slugs and other loose parts can come in contact with the cushion unit.

DIAMOND T MOTOR TRUCK CO., Chicago, is using an interesting method of withdrawing tires from storage and serving them to the truck assembly line. A special tire handling cradle was built with a floor plate in which small rollers are set and an upright cage that will receive a stack of 10 tires. This unit, when needed, is picked up by a Clark fork truck and attached to the truck's horizontal plate by two pins. The truck operator, without dismounting, picks up a stack of 10 tires, lets down the manually operated hook which keeps the stack stable in case of a quick stop, runs the load to the assembly line, where it is deposited on the floor or elevated to a mezzanine near the assembly line.

Inasmuch as the tires extend beyond the front edge of the lifting plate, the stack is easily placed by simply tilting the load until the outer portion of the bottom tire touches the floor, then backing out from under the load. One man brings up to assembly in one hour enough tires for a day's run, a job that formerly took two men with hand trucks half a day. The particular model truck used by Diamond-T lifts 3500 lb. to 108 in. in 25 sec., travels at speeds from one to seven m.p.h., and is manufactured by Clark Tructractor Division of Clark Equipment Co., Battle Creek, Mich.

# Modern Fuels and

By P. M. HELDT

LUBRICANTS for engines in heavy-duty service furnished the chief topic for discussion at the S.A.E. National Fuels and Lubricants Meeting, which was held at Hotel Mayo, Tulsa, Okla., Nov. 7 and 8. Problems connected with the use of Diesel engines in trucks and buses also came in for considerable attention. There was one paper on lubricating greases, dealing mainly with their rational classification, and aircraft and aircraft-engine problems were discussed at one of the technical sessions and one of the two dinner sessions scheduled. The speaker at the first dinner session was Wm. B. Stout, whose theme was "The Second Coming of Aviation." At the second dinner session, which concluded the meeting, there was a debate between teams from the University of Oklahoma and Kansas State College on the subject "Resolved that Higher-Compression Tractor Engines Are To Be Preferred for Tractor Power Equipment," the Kansas boys taking the affirmative and the Oklahomans the negative. Attendance at the meeting, which was the fifth in a series staged by the S.A.E. Fuels and Lubricants Activity, was quite satisfactory.

### *Diesel Trucks in Service*

"ON THE Road with Dodge Diesel" was the title of a paper by L. T. Knocke, chief Diesel engineer of Chrysler Corporation. Mr. Knocke gave details of service and maintenance operations in connection with a number of Diesel truck fleets and Diesel industrial units. The first Dodge Diesel truck, it was brought out, was sold to the White Star Division of Socony-Vacuum Oil Company of Detroit on Feb. 14, 1939, and at the present time a number of trucks in various parts of the country have rolled up mileages of more than 100,000. In most of the truck services the fuel mileages have been substantially 50 per cent greater than with gasoline-engined trucks of equal capacity and power in the same services. It was found that when an engine required reconditioning, as a rule all that was needed was to install new pistons and rings, the cylinder bores showing very little wear. In the case of a tractor-trailer combination used in a dairy business, with a g.v.w. of 32,500 lb. (which was said not to vary by more than 1500 lb. because ice cream is unloaded and fresh milk taken on alternately), the fuel mileage was given as 8 miles per gal., as compared with 5 miles for a comparable gasoline truck in the same service. This gives the very creditable performance figure of 128 ton-miles per gal. for the Diesel truck. In all of the services dealt with in the paper a worthwhile saving was shown by the Diesel truck over comparable gasoline-engined trucks. In the discussion the author admitted that systematic maintenance is essential to the success of Diesel trucks. In a number of cases where truck drivers became truck owners and apparently neglected the maintenance phase of the business, there was trouble aplenty.

### *Rationalizing Lubricating Greases*

MARTIN B. CHITTICK of The Pure Oil Company, thought there was need for improvement in the nomenclature of lubricating greases. The A.S.T.M. has defined a lubricating petroleum grease as "a semi-solid or solid combination of petroleum product and a soap, or mixture of soaps, with or without fillers, suitable for certain types of lubrication." This definition, Mr. Chittick said, while good as far as it goes, does not go far enough, as it does not cover the entire field of products commercially known as lubricating greases. Two products not covered are certain extreme-pressure lubricants—the sulfurized, phosphorized and chlorinated fatty-oil types — and tractor roller-bearing greases, which are mixtures of mineral oil with various proportions of abrasive-free asbestos floats as thickening agents.

The author asserted that the term grease was nondescriptive, out-of-date, and could not be correctly defined technically. He suggested that it should be eliminated from our technical nomenclature, and that the term lubricant should be applied to all products used to reduce friction and prevent wear between moving parts. He would divide lubricants into three classes, the first comprising pure mineral oils, the second mineral oils mixed with other agents which do not increase its viscosity, and the third, mineral oils mixed with thickening agents, such as metallic soaps, which increase the viscosity above that of the mineral oil.

Mr. Chittick's paper included a bibliography on lubricating greases containing no less than 438 items, about which complimentary remarks were made by a number of speakers.

### *Pioneering the Diesel In Long-Distance Bus Service*

AN INTERESTING paper on Operating and Maintenance Problems of Diesel Engines in Bus Service was presented by W. A. Taussig of the Burlington Transportation Company. This concern is a subsidiary of the Chicago, Burlington & Quincy Railroad, which pioneered the Diesel engine in passenger-train service

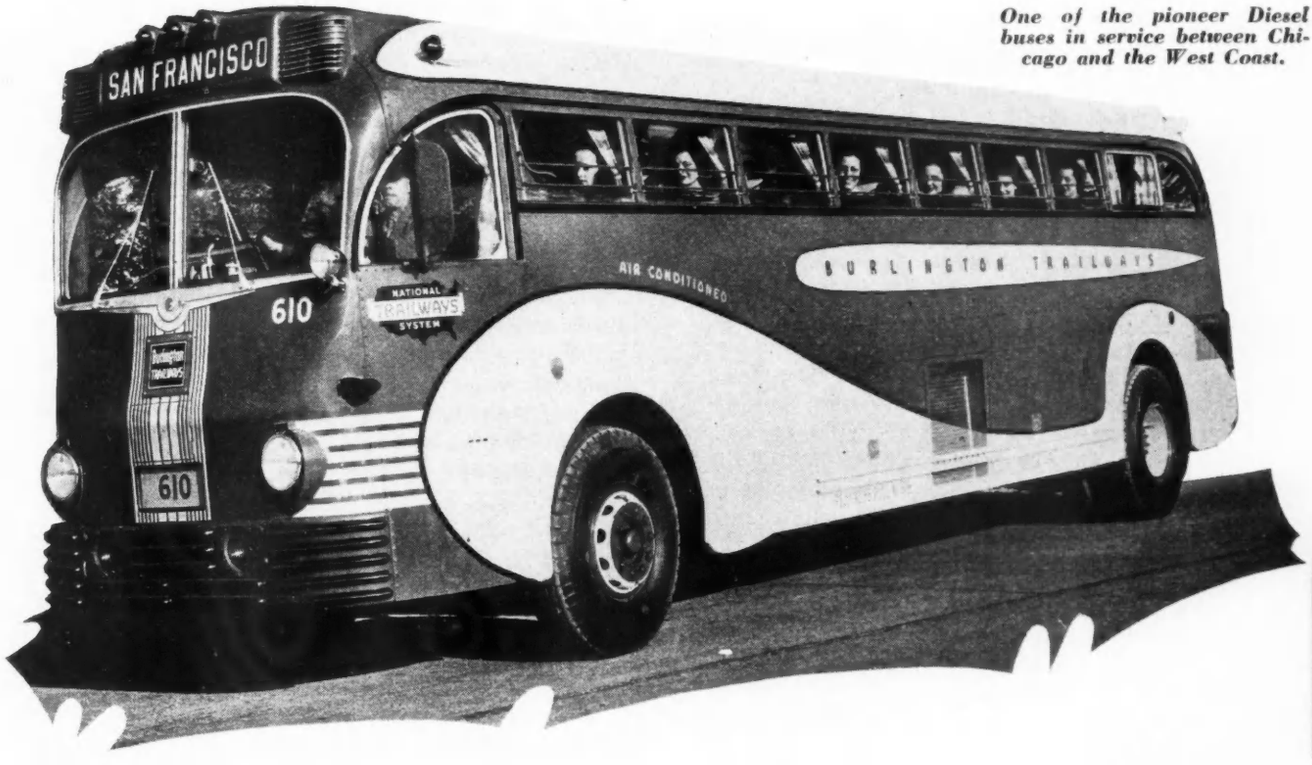
# Lubricants for Diesels

## *National Fuels and Lubricants Meeting of the SAE in Tulsa is fifth in the series*

in this country, and we were told that the parent company had brought considerable pressure to bear on its subsidiary to get it to adopt Diesels and take advantage of their economic possibilities. The bus company at first hesitated, because of the risks involved, but toward the end of 1938 a large manufacturer of Diesel-powered buses offered to assume full responsibility for both the bus and the engine, which was reassuring. Then another problem arose. A total of 21 buses were required for a service between Chicago and the West Coast (San Francisco and Los Angeles). In view of the newness of the Diesel in this field it seemed the part of wisdom to start with two or three Diesels and use gasoline buses for the remainder of the service. However, the benefits from the use of Diesel engines were to come in the form of reductions in fuel costs; it was found that Diesel fuel could be purchased at a considerably lower price in tank-car lots, but if only two or three Diesel buses were being operated it would not be practical to buy fuel in tank-car lots for individual filling stations. It was, therefore, decided to use Diesels exclusively, and an order for 21 Diesel-engined buses was placed—Yellow Coach buses with G.M. two stroke engines.

One advantage of the Diesel engine, especially in services in mountainous territory, is that its torque holds up well at low speeds, and drivers of the Burlington Diesel buses often found it possible to safely overtake competing gasoline buses of the same axle ratio and wheel diameter, although the six-cylinder gasoline engines had a rating of 185 hp., against 165 of the Diesel. The six-cylinder, two-stroke Diesel engines, moreover, were found to cause less vibration of the bus. Diesel engines are sensitive to high speed, and although the engines are provided with a governor designed to hold them down to 1850 r.p.m. maximum, on down grades the engine is apt to "run right through the governor" and attain a speed of 2070 r.p.m.

This was the first application of Diesel engines to long-haul bus transportation, and inexperience resulted




*One of the pioneer Diesel buses in service between Chicago and the West Coast.*

in many mishaps during the first four months of operation. The same engines which had given very satisfactory service in city operation failed in fast interstate service, and particularly on long grades at high altitudes. During the second month there were 30 road failures. In the western territory there are distances of from 500 to 750 miles between service stations, and road failures, therefore, were quite serious, as it is not an easy task to tow a large bus some 300 miles over high mountain ranges. Most of the troubles experienced were due to running at practically maximum power over long distances, a condition not met with in local transportation. Directly west of Cheyenne is Sherman Hill, an upgrade 35 miles in length, on which the altitude increases from 6060 to 8835 ft. Very few of the grades in this section are sufficiently steep to necessitate dropping into third gear, and most of the distance is traveled in high gear at about 40 m.p.h., the engine developing its maximum torque over most of the distance. This long ascent is followed immediately by a rapid descent during which the engine will cool and still run at high speeds. About 200 miles farther west is the Continental divide, and most of the failures occurred near that point on a long level stretch. It was believed that damage to the pistons began on Sherman Hill and that only after 200 miles further running did it become sufficiently serious to cause seizure.

The first serious trouble was with blower rotors. These were found to have insufficient clearance for these particular operating conditions, and rotors with much greater clearance were immediately installed. As an example of the bus manufacturer's cooperation in this pioneer enterprise the author stated that immediately after the first blower seizures had occurred, the manufacturer shipped replacement rotors for the whole fleet, many of them by air express, to forestall further failures. After five engines had failed through piston seizure the manufacturer sent his experimental engineer and Diesel expert and representatives of his service department to Cheyenne, the nearest shop to the scene of most of the road failures.

Piston seizures pointed to the need for more effective cooling and perhaps better lubrication. Larger radiator fans were installed on two buses and reduced the temperature difference between the water manifold over the rear cylinder and the radiator top tank from 23 to 3 deg. Fahr. All of the buses were then equipped with larger fans. To improve the lubrication of the pistons, the crankcase vapors were delivered to the blower intake by a pipe. While this procedure improved cylinder lubrication, it had to be abandoned again because it led to excessive oil consumption, accumulation of excessive amounts of oil in the air box, and deterioration of the synthetic rubber disk of the "emergency-stop" blower-inlet valve. Oil accumulating in the air box would be blown into the cylinders in slugs and cause premature combustion.

An increase in the piston skirt clearance from 0.005 to 0.010 in. practically eliminated piston seizures, but it also affected the fuel and lubricant consumption adversely. A thorough investigation of the troubles was then made in the field by three representatives of Yellow Truck & Coach Mfg. Co. and two service representatives of General Motors Diesel Division, and as a result of their findings a number of changes in design were made, including the following:

To increase the rate of flow of cooling oil to the under side of the piston head, the check valve in the oil passage of the connecting rod was eliminated, and to compensate for the resulting reduction in pressure in the lubricating system, a larger oil pump was installed.

The engine being mounted transversely on the rear of the chassis, when rounding sharp curves there was a tendency for the oil to be thrown to one end of the oil pan, with the result that the oil inlet would become exposed temporarily and the oil pressure drop as much as 75 per cent. This was overcome by redesigning the oil pan, providing it with a deep sump at the center.

Aluminum piston-pin keepers were replaced with circular steel disks and snap rings. The crankcase was ventilated to the atmosphere. A cleanable-type of muffler was installed, to prevent fouling and excessive back pressure in the exhaust. The capacity of the absorption-type oil filter was doubled, and tin-plated compression rings were installed. The piston wall immediately above the piston bosses was increased in thickness by about 50 per cent. This reduced distortion of the piston under load and permitted a reduction in the piston clearance from 0.010 to 0.007 in.

The junction between the head and stem of the exhaust valve was strengthened to prevent breakage. Improvements were made in the design of the blower drive-gear hub and bearing assembly, and the flexible metallic tube in the line from the fuel pump to the injector supply manifold was replaced by a synthetic rubber hose.

Stresses on blowers seem to be especially severe in long-distance operations. It was found necessary to increase the rotor clearance from 0.004 to between 0.012 and 0.015 in., and even this did not entirely prevent seizures.

At the beginning there was a certain amount of trouble from dirt in the fuel system, which was evidently introduced in the manufacturing operations. At the present time great care is taken in handling the fuel; injectors are inspected at reasonably frequent intervals, and the author said that under such conditions the injector is just as reliable as a good ignition system.

Cooperation between the bus manufacturer, lubrication engineer and bus operator succeeded in cutting down road failures from one in 12,000 miles to one in 100,000 miles. Toward the end of 1939, after changes had been made in engine design, lubricating oil, maintenance procedure, and driving technique, the opportunities for savings on fuel cost seemed to overbalance any possible disadvantages, so two more Diesel buses were ordered, and 15 more in 1940.

## *Light-Plane Maintenance*

THE subject of maintenance for light aircraft was discussed by R. W. Rummel, chief engineer of Rearwin Aircraft & Engines, Inc., who expressed the opinion that with a large increase in the production of light aircraft, maintenance costs would follow the same downward trend as they have in the automobile

field. Maintenance is an item which must, necessarily, be considered from the time of the first layout or basic design computations until the airplane is completed and in production. In addition it must be carefully reviewed from time to time by trained maintenance experts and engineers in an effort to further reduce costs. Occasionally, through close observance of field problems, minor changes in design can be executed which result in saving dollars for the owners.

## Heavy-Duty Crankcase Oils

A PAPER on Crankcase Oils for Heavy-Duty Service was presented by H. R. Wolf, head of the General Chemistry Department of the Research Laboratories Division, General Motors Corporation. Mr. Wolf brought up the subject of the best name for compounded crankcase oils for heavy-duty service and said he preferred "heavy-duty oils" to "truck and bus oils" and "Diesel-engine oils," as either of the latter might tend to work against their use under certain conditions where it would be beneficial. The author said both dynamometer and field tests had demonstrated that heavy-duty oils are essential to satisfactory operation under the most severe service conditions in both gasoline and Diesel engines.

Routine refinery inspection tests, including 12 items, from gravity to emulsion, give no clue to stability or resistance to oxidation, or to the ability of the lubricant to prevent engine deposits. Changes in refinery methods and the use of inhibitors have altered the oxidation characteristics of oils to such an extent that products having the same inspection limits may act entirely differently in service. This was first recognized several years ago when copper-lead and cadmium bearings were found to corrode when lubricated with solvent-refined oils. Solvent refining removed some of the objectionable sludge-forming materials, but it also removed the natural oxidation inhibitors in the crude. In light service there was a definite reduction in engine deposits with these oils, but in heavy-duty service the oils oxidized rapidly and formed large quantities of acidic compounds. The cause of the bearing corrosion was quickly recognized, and oxidation inhibitors were added to the oil. Similarly, some of the first detergents used in Diesel engine lubricating oil were metallic soaps which under service conditions acted as oxidation catalysts. Crankcase oils containing this type of detergent function properly only if the bearings are of a non-corrodible type and the crankcase is drained sufficiently frequently to prevent overtaxing the ability of the detergent to hold oxidation products in suspension.

Oils for use in high-speed heavy-duty Diesel engines require an oxidation inhibitor and a suitable detergent or dispersion agent. Both an inhibitor and a detergent are needed also in oils for heavy-duty truck and bus gasoline engines. In passenger-car engines operated under average owner-driver conditions an oxidation inhibitor is far more important than a detergent, but under extreme high-speed driving conditions some degree of detergency may be required also, to minimize engine deposits and maintain new-car performance over a longer period. Low-viscosity oils are more subject to oxidation than the more viscous grades, and may require larger proportions of oxidation inhibitor. Measures taken to prevent sludge formation in heavy-duty service are no solution of the "water-sludge" problem, that is, the problem arising out of the formation of sludge in the crankcase during the winter months, when water accumulates in the crankcase, particularly in light city driving and in house-to-house delivery.

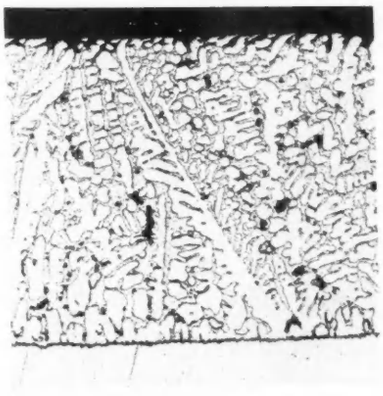


*Fig. 1 — Section from unloaded area, 65 magnifications. (The steel backing is shown at the bottom, the copper-lead bearing metal in the middle, while the black strip at the top is empty space).*

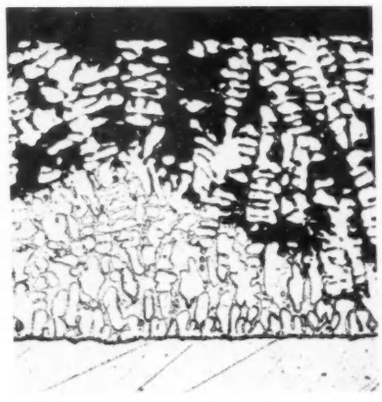


*Fig. 2 — Section from loaded area, 65 magnifications. The loss of lead is due to action of detergent compound.*

Mr. Wolf said that service complaints relating to lubricant performance for the most part come under four headings, viz., valve sticking in city driving, bearing corrosion in high-speed driving, water-sludge formation in low-temperature winter operation, and oxidation due to high temperatures which may occur in moderate-speed as well as in high-speed driving.

The precipitation of resinous or varnish-forming oxidation products on the addition of fresh oil is responsible for many present-day service complaints. How sludge is formed when fresh oil is added to an oil which has previously been subjected to oxidizing conditions was demonstrated by the speaker.

Conditions under which dynamometer tests of lubricating oils are run, with Chevrolet and G.M. 71 Diesel engines, were outlined. In a series of runs on the Chevrolet engine, when a medium quality 20-W oil was used the engine was very dirty at the end of 2000 miles, whereas with highly refined 10-W oil the engine was quite clean after the same length of time,

yet the pistons were stuck at the end of both runs. The varnish deposited from the medium-quality oil was quite dark, while that from the highly refined oil was transparent. The runs are made at an engine speed corresponding to 60 m.p.h. road speed. When the highly refined oil had either an inhibitor or a detergent or both added, the pistons were free and there was no varnish at the end of the run.

Analysis of data on crankcase-oil deterioration indicates that oxidation and decomposition occur both in the combustion chamber and in the crankcase. Oxidation in the combustion chamber seems to occur if the engine is used as a brake on long descents with the ignition shut off.

During the past year attention has been focused on failure of copper-lead bearings in heavy-duty service. It is either a case of loss of lead due to corrosive action of the lubricant, or mechanical failure due to fatigue. Corrosion and fatigue are greatly accelerated by an increase in bearing pressure, consequently tests made in full-size multi-cylinder engines most closely approximate service conditions. Loss of lead may be caused by the solvent action of acidic products formed by oxidation of the base oil, which may be accelerated

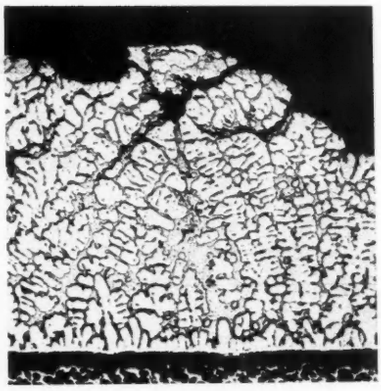


*Fig. 3 — Fatigue failure 65 magnifications. Note lead extends to edge of fatigue crack.*

by the catalytic effect of metallic soaps used as detergents, or it may be caused by the action of metallic soaps under pressure at heavily loaded bearing areas. Figs. 1 and 2 are photomicrographs of sections of the upper half of a connecting-rod bearing shell after a 500-hr. Diesel-engine test. The copper appears as a bright constituent, the lead gray; areas in which the lead has been removed by corrosive action of oxidation products or by the action of the detergent under pressure appear black. Fig. 1 is typical of the unloaded and moderately loaded sections of the bearing, while Fig. 2, which shows loss of lead that in one section extends to the steel backing, is characteristic of the highly loaded area of the same bearing. The corrosion indicated by Fig. 2 was due entirely to a metallic-soap detergent, as tests made with other lubricants containing the same oxidation inhibitor but no detergent, showed no loss of lead from the bearing surface. Such metallic soaps as calcium naphthenate and aluminum stearate appear to decompose under the pressure and temperature conditions existing at the high-pressure areas of heavily loaded bearings, yielding free acids

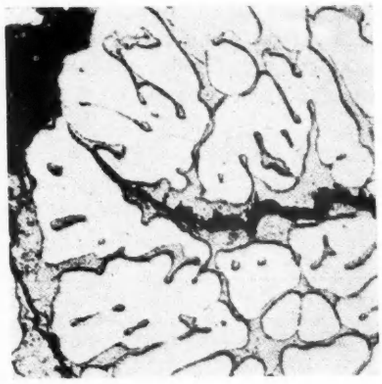


*Fig. 4 — Fatigue failure, 325 magnifications. Note lead adhering to copper along fatigue crack.*

which attack the lead. There are other metallic compounds with detergent properties which do not break down under the conditions at the high-pressure areas or do not form acidic compounds on decomposition, and which, therefore, do not cause bearing corrosion.

Copper-lead bearing failure due to fatigue can be readily distinguished from failure due to loss of lead. In fatigue failures the lead in the copper-lead structure extends to the surface of the fatigue crack. This is illustrated by the photo-micrograph Fig. 3. In Fig. 4 lead can be seen adhering to the copper along the fatigue crack.

Temporary relief from lubrication troubles can be obtained by decreasing crankcase temperatures, but the tendency in design is definitely toward higher specific outputs, and if any step is taken to reduce crankcase temperatures, the designer immediately takes advantage of it to boost the output.

A recent development in corrosion-resistant bearings is used in the 1941 Buick engine. It has a hard, strong matrix filled with a high-lead, corrosion-resistant babbitt. If the matrix is completely covered with a thin layer of babbitt, Fig. 5, the bearing may be considered to possess all of the frictional characteristics of babbitt and many of the structural characteristics of copper-lead bearings. Where high resistance to fatigue is required the bearing surface may be lowered, as shown in Fig. 6, to expose the hard matrix. This type of bearing is being tested under heavy-duty operating conditions. While this new type of bearing, if it should be developed commercially, would not be

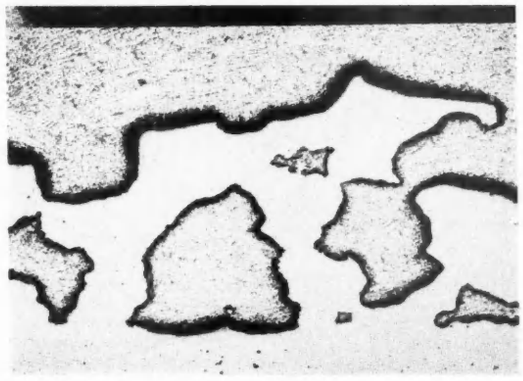


*Fig. 5—Photomicrograph of Buick bearing, 60 magnifications.*

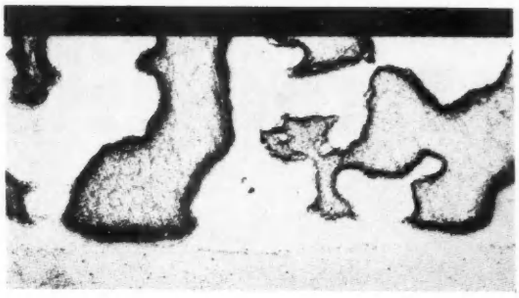


*Fig. 6—Experimental heavy-duty bearing in which the hard matrix is exposed on the bearing surface. 60 magnifications.*

affected by acidic compounds, oxidation products that result in resinous, varnish-forming materials or in "coffee grounds" would continue to be objectionable.

### Modern Diesel Lubricants

DR. ULRIC B. BRAY, consulting chemist and engineer of Los Angeles, in a paper on "Modern Lubricants for Modern Diesels," gave credit to Caterpillar Tractor Company for having been first to recognize the shortcomings of plain mineral oils as lubricants for high-speed Diesels and inspired a research program on the subject which gained momentum ever since. It was at one time believed that the newly developed solvent-refining processes might yield an oil that would meet Diesel requirements; this hope, however, proved to be unfounded, and attention was then turned toward additives. Ring sticking was almost completely eliminated by the addition of soap-type compounds to mineral oils. While such compounded oils, consisting usually of naphthenic oils with from 1 to 3 per cent of aluminum naphthenate added, had been known for years under the name Castor machine oil, credit must be given to the Standard Oil Co. of California for recognizing the beneficial results from aluminum naphthenate in Diesel lubricating oils and for having developed a compounded oil of this type for Diesel lubrication.

The next step in this direction announced to the public was the use of the calcium soap of a synthetic acid produced by combining benzene, $C_6H_6$, with oleic acid, $C_8H_{17}CH:CHC_7H_{14}COOH$, in the presence of aluminum chloride as a catalyst. The resulting acid is known as phenyl stearic acid, and the soap as calcium phenyl stearate. Oils containing this synthetic soap showed relative freedom from engine deposits and a notable reduction in wear.

Attention was next turned to preventatives against scratching or scuffing of rings, liners and pistons. As a means of relief from this trouble a synthetic soap containing chlorine was developed—calcium dichlorostearate. It was assumed that the scoring or scuffing was a welding phenomenon akin to that occurring when hypoid gears fail in severe service, and that it could be prevented by the use of anti-welding agents such as chlorine or sulfur.

Four outstanding lubrication difficulties in connection with high-speed Diesels have been ring-sticking, scratching or scuffing, excessive wear, and bearing failure, and in order to alleviate these difficulties the oil should have detergency, high film strength, a high degree of oiliness, a low carbon-forming tendency, stability against oxidation at engine temperatures, and non-corrosiveness to engine bearings.

Detergency may be defined as that property of the oil which assists in removing dirt from engine parts or preventing its accumulation thereon. It must not be confounded with solvent action, as it operates through colloidal phenomena, the contaminants being held in suspension by some kind of pepizing action. The idea of "detergency" was introduced by the author at the S.A.E. Fuels and Lubricants Meeting in Tulsa in 1937, and since that time the terms "detergents" and "detergency" have become every-day expressions in connection with crankcase oils. As might be expected, the largest practical dose of detergents can carry only so much dirt in suspension, and for optimum results the detergent oils must be replaced either continuously or periodically. The most powerful detergents used to date are oil-soluble soaps or salts of true organic acids, of which calcium phenyl stearate is an example. The next most powerful detergents are composed of a metal constituent and an organic compound having acidic or salt-forming properties, such as the calcium salts of complex phenolic compounds. Another group of detergents consists of complex organic compounds without metallic constituent, such as ketones, esters and polymerized fatty substances (lecitins), all of high molecular weight.

High film strength probably should be defined as anti-welding property. Its function, according to the author, is to prevent destructive scratching or scuffing resulting from microscopic welding of rings to liners when the usual lubricating film is ruptured. The scuffing tendency can be reduced by addition to the oil of an agent which modifies the surface molecules sufficiently to prevent fluxing or intermingling of iron molecules. Sulfur, chlorine, phosphorus and oxygen are known to have this effect.

Oiliness was defined by the author as that property of the lubricant which results in reduced wear under normal operating conditions, when scratching or scuffing is not a factor. It was unfortunate, the author said, that many people connect it with friction rather than with wear—unfortunate because not one operator in a dozen will raise an eye brow over "less friction," but most operators will develop an interest in a reduction in wear. The most effective "oiliness" agents all belong to the class of oxygenated compounds, which includes organic acids, esters, ketones, alcohols, and metallic derivatives of these. A widely accepted theory is that the oxygen part of the molecule has a great affinity for the metal surfaces and tends to replace the hydrocarbon portion of its own or other molecules from the metal surface. Thus by "selective adsorption" there is a concentration of the oxygenated compounds on the frictional surfaces, and the greater affinity of the compounds for the metal surfaces results in greater protection of the latter against wear. Oil-soluble soaps of true organic acids, ketones, acids, and esters probably rank first among oiliness agents.

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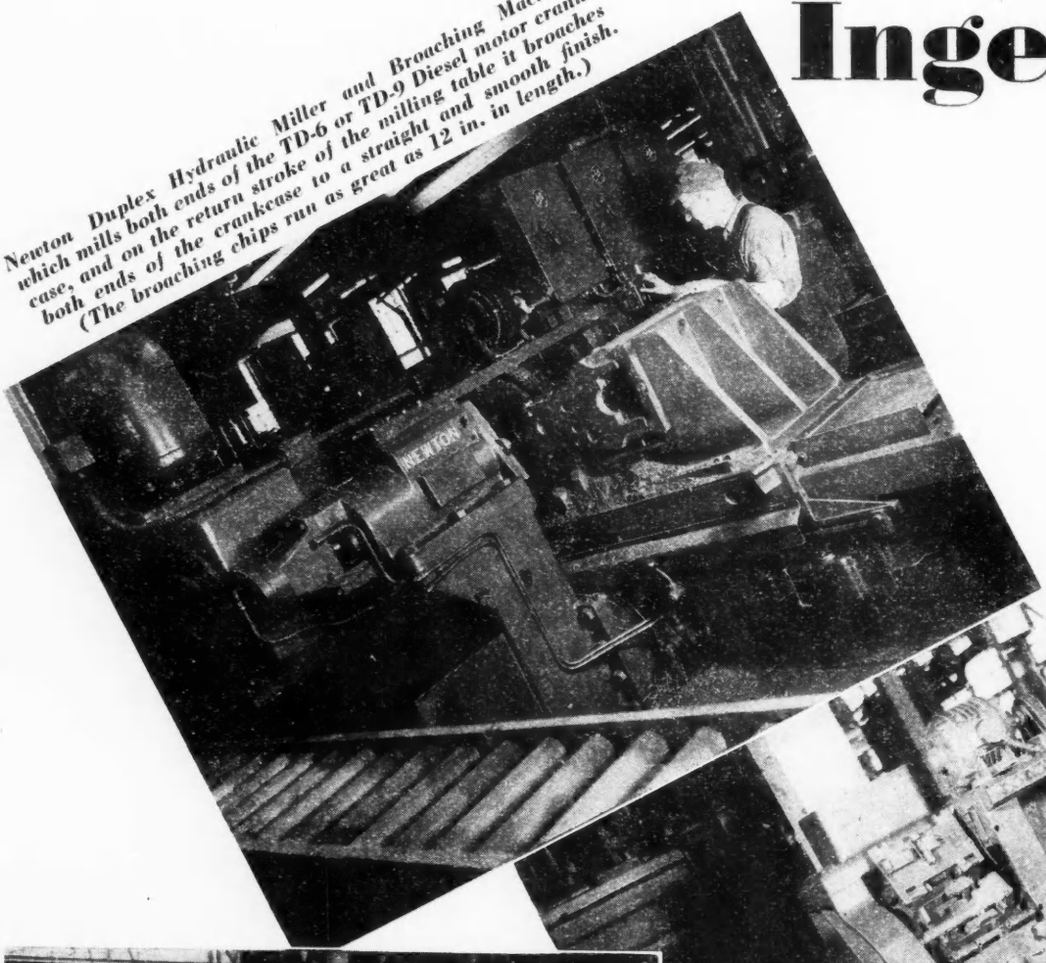
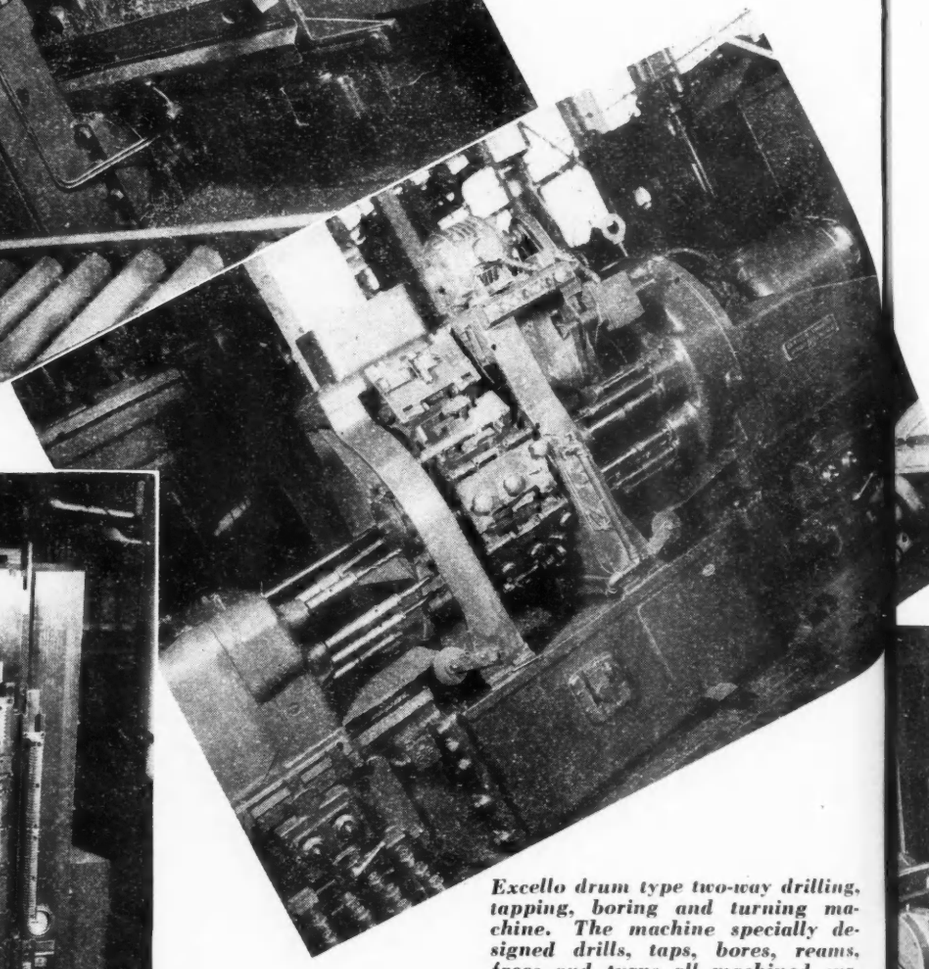
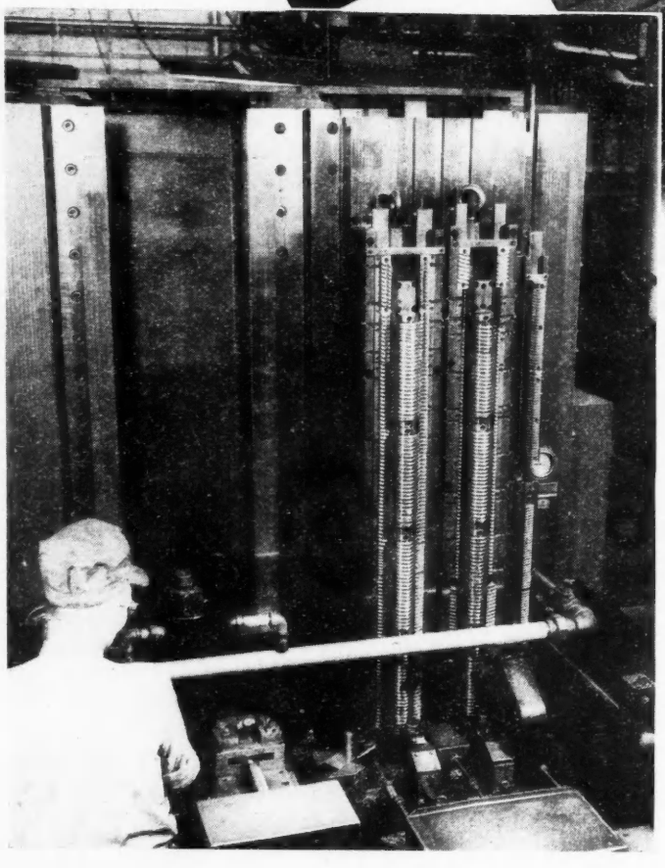
# Ingenious




*Newton Duplex Hydraulic Miller and Broaching Machine, which mills both ends of the TD-6 or TD-9 Diesel motor crankcase, and on the return stroke of the milling table it broaches both ends of the crankcase to a straight and smooth finish. (The broaching chips run as great as 12 in. in length.)*



*Excello drum type two-way drilling, tapping, boring and turning machine. The machine specially designed drills, taps, bores, reams, faces and turns all machined surfaces on oil pump bodies for Diesel motors in one operation. Three different size oil pump bodies are machined on this operation.*



*Oil Gear 40-ton double slide vertical broaching machine, straddle broaching sides of connecting rods both ends and straddle broaching connecting rod caps on one slide and broaching back face and half round diameter of connecting rod and connecting rod cap on the other slide. All clamping is automatic.*

# Grouping of Machines

## *at the Milwaukee plant of the International Harvester Corp. speeds production on a line of unusual flexibility*

THE NEW Diesel engine production line recently placed in operation by International Harvester Company at its Milwaukee Works is interesting by reason of two departures from ordinary practice.

The first is a marked change in grouping of machines, combined with a large increase of automatic handling of work.

The second is the unusual flexibility of the line in equipment and layout, which enables the company to run three different engines down the same line with only minor changes in equipment, principally the changing of working heads on some of the machines. The line accommodates two sizes of Diesel engines and a gasoline adaptation of one of the Diesels. The engines are used both in the company's tractors and in stationary power units.

The new engine line was designed and installed under the supervision of J. E. Harris, superintendent of Milwaukee Works, and V. A. Guebard, assistant superintendent.

The engine line is located in a sawtooth-roof building, well ventilated and equipped with fluorescent lighting which develops an average of 25-ft. candlepower throughout the building, practically the equivalent of normal daylight.

### *Crankcase Line*

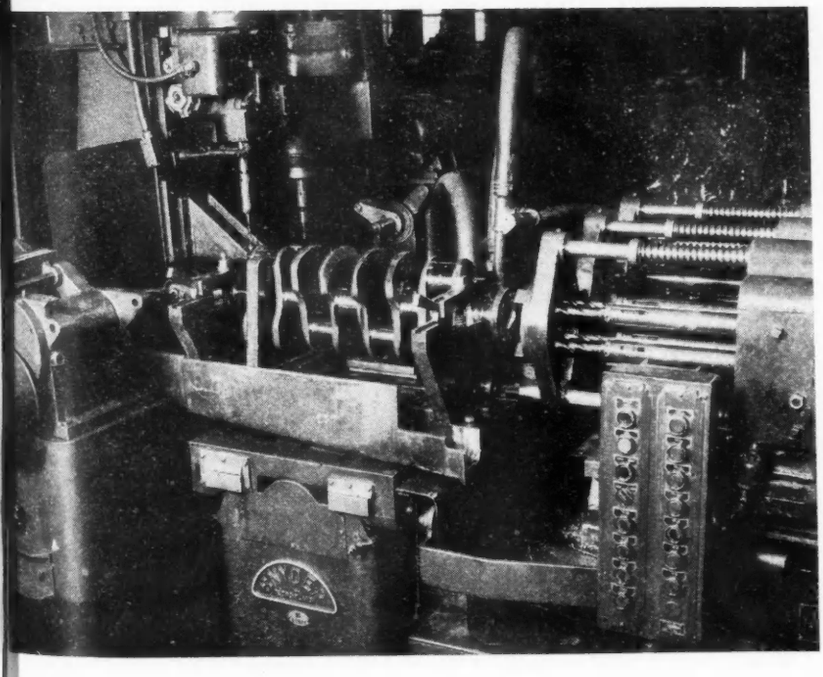
On the first operation, after the rough casting is clamped down, a Newton heavy-duty rotary milling machine mills the top and bottom. On the return stroke, the same surfaces are finish-broached without appreciable loss of time. The finishes achieved are excellent as gasket surfaces.

The two ends of the crankcase are also combination machined and broached on a Newton milling machine.

Various operations such as the drilling of locating holes, roughing of cylinder bores, and straddle milling of bearing seats and notches are handled on standardized equipment.

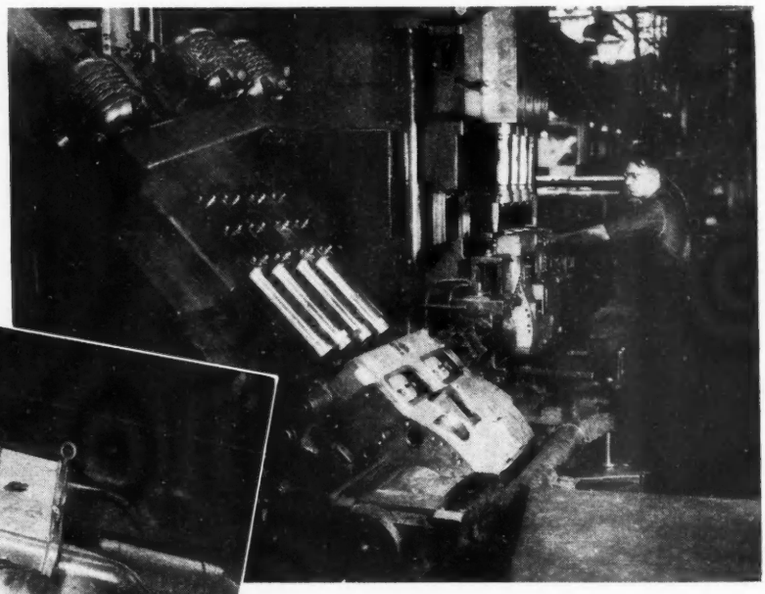
By gravity feed conveyor the crankcase is then delivered to a group of three special Greenlee automatic transfer machines, operated from one master push button control board. These machines drill and tap the rest of the holes in the crankcase, automatically, except for the camshaft and crankshaft borings.

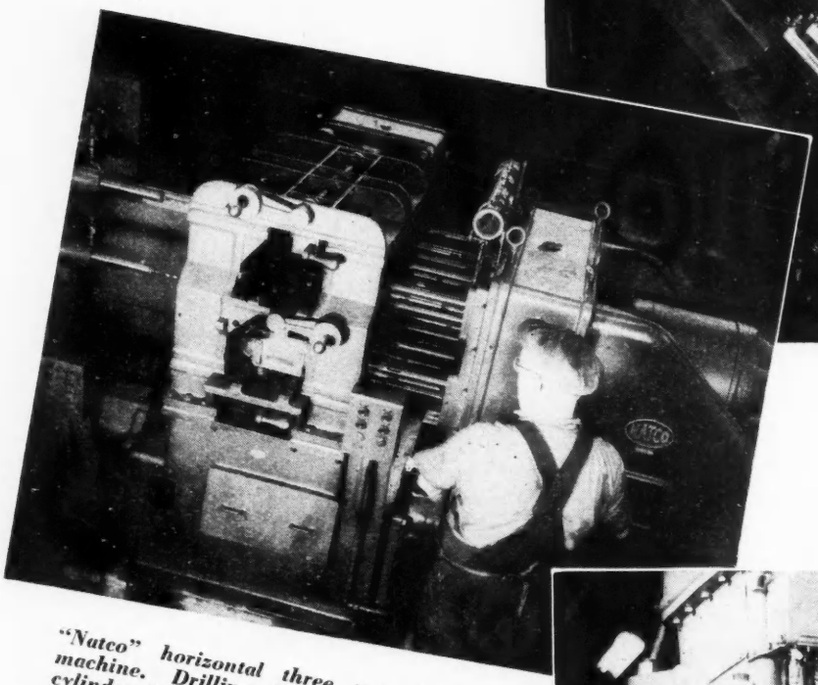
This work is controlled by a series of electric controls and limit switches. Various locking devices on the equipment eliminate the possibility of confusion or



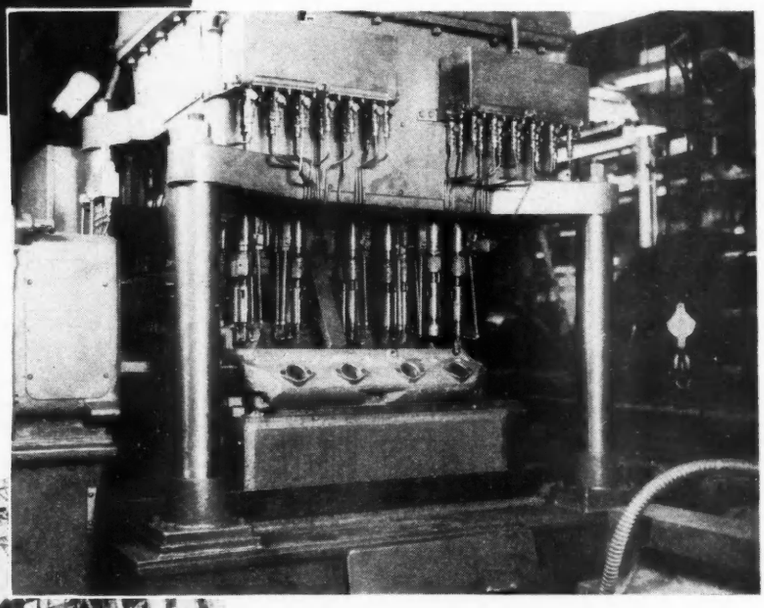
***Drilling, reaming and tapping both ends of a Diesel motor crankshaft on a Snyder special semi-automatic drilling, reaming and tapping machine. On this machine all the operator does is to load and unload the machine, push the proper button on the control panel and the machine goes through the various stages of drilling the flywheel bolt holes on end of the crankshaft while drilling the starting crank pin hole on the other end, then drilling the flywheel dowel pin holes on one end while drilling the starting crank pin set screw hole on the other end, then reaming the flywheel dowel pin holes, and tapping the set screw hole on the other end; finally, tapping the flywheel bolt holes and reaming the starting crank drive pin hole. The table then returns to the starting position and the machine is ready to unload and reload.***

*(Top) Shows the semi-finish bore on the crankcase for the dry liner cylinder sleeve on a four spindle "Moline" boring machine, and the finish bore for the dry liners on a four spindle "Excello" inclined precision boring machine. These cylinder sleeve bores are held to .0002 of an inch for parallel and out of round.*

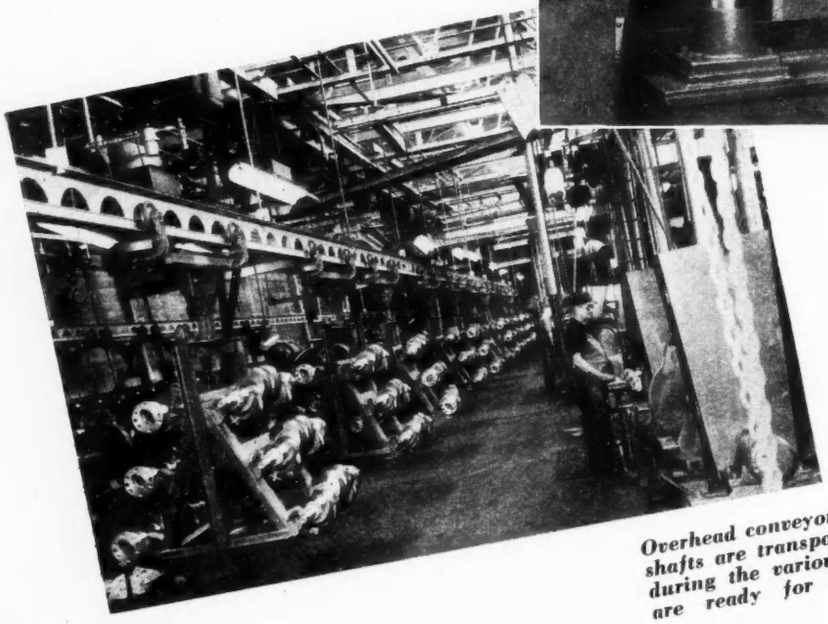




*"Natco" horizontal three way drilling machine. Drilling TD-9 Diesel motor cylinder heads. These machines are designed and equipped to machine both the TD-6 and TD-9 Diesel motor cylinder heads. In the picture we see the operator drilling a TD-9 cylinder head in the lower magazine of the fixture. The TD-6 cylinder heads are drilled in the upper magazine. The drill heads are tooled up to drill either cylinder head.*



*Tapping TD-9 Diesel motor cylinder heads on a three way Natco tapping machine. Like the Natco special drilling machines these special tapping machines are also designed and equipped to tap both the TD-6 and TD-9 cylinder heads.*



*Overhead conveyor on which the Diesel motor crankshafts are transported from one machine to another during the various machining operations until they are ready for delivery to the motor assembly department.*

# Crankcase Routing

OPERATION AND EQUIPMENT

**DIP** in sealer

**STRADDLE** MILL top and bottom, **MILL** bearing cap seats and side pads. **BROACH** top, bottom, and bearing cap seats
Special Newton combination milling and broaching machine
Push button control

Combination **DRILL** and **REAM** (2) locating holes, **DRILL** (2) wick holes, and **HAND CHAMFER** (2) locating holes
Natco multi-spindle vertical drilling machine
Push button control

**ROUGH BORE** and **COUNTERBORE** cylinder sleeve bores
No. 10 Moline 4-spindle vertical boring machine
Push button control

**STRADDLE MILL** and **BROACH** both ends.
Special Newton combination milling and broaching machine equipped with torque motor clamping on the fixture. Push button control

**STRADDLE MILL** center bearing and **MILL** bearing liner notches
Special Fitchburg rise-and-fall milling machine equipped with air-operated fixture. Push button control

**MILL** wick groove and side pads
Special Fitchburg horizontal and vertical milling machine. Push button control

**DRILL, COUNTERBORE,** and **TAP** cylinder head stud holes in top drill, **COUNTERBORE** and **TAP** bearing cap stud holes, oil pan cap screw holes in bottom, **DRILL** water circulating holes in top, **DRILL** angular oil holes in bottom, **DRILL** and **SEMI-FINISH-REAM** valve tappet holes and **WASH**
Special Greenlee 15-station, semi-automatic drilling and tapping machine equipped with hydraulic clamping and automatic hydraulic transfer mechanism, safety limit switches on all clamps and fixtures, push button control panel and a suction system for removing chips from crankcases in process and from the chip pit of the machine. In conjunction with the Greenlee machine, there is a special Alvey-Ferguson washing machine and automatic rollover fixture for positioning the case for the following operations which are operated automatically from the transfer mechanism

**ROUGH BORE** pump bore, crankshaft, and camshaft bores. **DRILL** oil galley holes full length of case, **DRILL** and **TAP** all holes in both ends of case, and **WASH**
Special Greenlee 15-station, semi-automatic drilling, boring, and tapping machine equipped with hydraulic clamping and automatic hydraulic transfer mechanism, safety limit switches on all clamps and fixtures, push button control panel, and a suction system for removing chips from the chip pit of the machine. In conjunction with the Greenlee machine there is a special Alvey-Ferguson washing machine which is operated automatically from the transfer mechanism

**DRILL** and **TAP** all holes in both sides, **DRILL** oil holes to main bearings, and **WASH**
Special Greenlee 9-station semi-automatic drilling and tapping machine equipped with hydraulic clamping and automatic hydraulic transfer mechanism, safety limit switches on all clamps and fixtures, push button control panel, and a suction system for removing chips from the chip pit of the machine. In conjunction with the Greenlee machine there is a special Alvey-Ferguson washing machine and an automatic rollover fixture for positioning the case for the following operations which are operated automatically from the transfer mechanism

**CLEAN** out bearing cap stud holes and oil line holes with air and oleum spirits and **ASSEMBLE** bearing cap studs in front and rear main bearings
Thor stud setter, on conveyor

**ASSEMBLE** intermediate and center main bearing, cap studs
Thor stud setter, on conveyor

OPERATION AND EQUIPMENT

**ASSEMBLE** bearing caps, washers, and nuts to case, stamp caps and case
Baush 2-spindle vertical nut runner conveyor

**SEMI-FINISH-BORE** crank bore, **FINISH-BORE** camshaft bore, **SEMI-FINISH-BORE** pump bore and idler gear shaft hole
Special Greenlee horizontal and vertical boring machine equipped with hydraulically operated fixture. Push button control

**FINISH-REAM** valve tappet holes
Natco 3 A H vertical 8-spindle boring machine equipped with hydraulically operated fixture. Push button control

**STRADDLE-FACE** center main bearing to size
Leland-Gifford vertical drill press. Push button control

**MILL** lubricating oil pump pad
Cincinnati horizontal milling machine equipped with air-operated fixture. Push button control

**TEST** cross-shaft hole with air for leaks
Hand fixture on conveyor

**PRESS** (2) cross-shaft bushing in place
Air press equipped with air-operated fixture

**ALIGN, REAM,** and **BURNISH** cross shaft bushings
Air motor on conveyor

**DRILL** (1) angular oil hole in front camshaft bore, **DRILL** pipe tap hole in rear end of case
Electric drill on conveyor

**PRESS** in (4) camshaft bushings
Special Logan horizontal hydraulic press equipped to press in 4 bushings at one time, also equipped with hydraulic clamping. Push button control

**FINISH-BORE** crank bore, finish-bore camshaft bushings and idler gear shaft hole, **REAM** (2) dowel holes in front end, ream (2) dowel holes in rear end, **FINISH-REAM** oil pump hole

**SIZE-REAM** oil pump hole with hand tool
Special Greenlee horizontal and vertical boring machine equipped with hydraulically operated fixture. Push button control

**LINE-REAM** crank bore to finish size
Air motor and special holding fixture on conveyor

**SEMI-FINISH-BORE, COUNTERBORE,** and **CHAMFER** cylinder sleeve bores
No. 115 Moline 4-spindle vertical boring machine equipped with hydraulically operated fixture. Push button control

**FINISH-BORE** cylinder sleeve
Ex-Cell-O 4-spindle precision angular boring machine equipped with hydraulic clamping

**FINISH-TAP** (6) pipe tap holes to depth in sides of case. **TAP** (1) pipe tap hole rear end of case
On conveyor

**FINISH-MILL** cylinder head contact face
Ingersoll 1-spindle vertical milling machine equipped with air-operated fixture. Push button control

**CHECK** cylinder sleeve bores and **MARK** for sizes
Electro-limit gage for sleeve sizes

**ASSEMBLE** sleeves in case
Air press equipped with maximum and minimum pressure control

**HONE** sleeves in case
Barnes No. 306 single-spindle vertical honing machine. Push button control

**CHECK** cylinder sleeve bores and **MARK** for size etching
Electro-limit gage for sleeve size

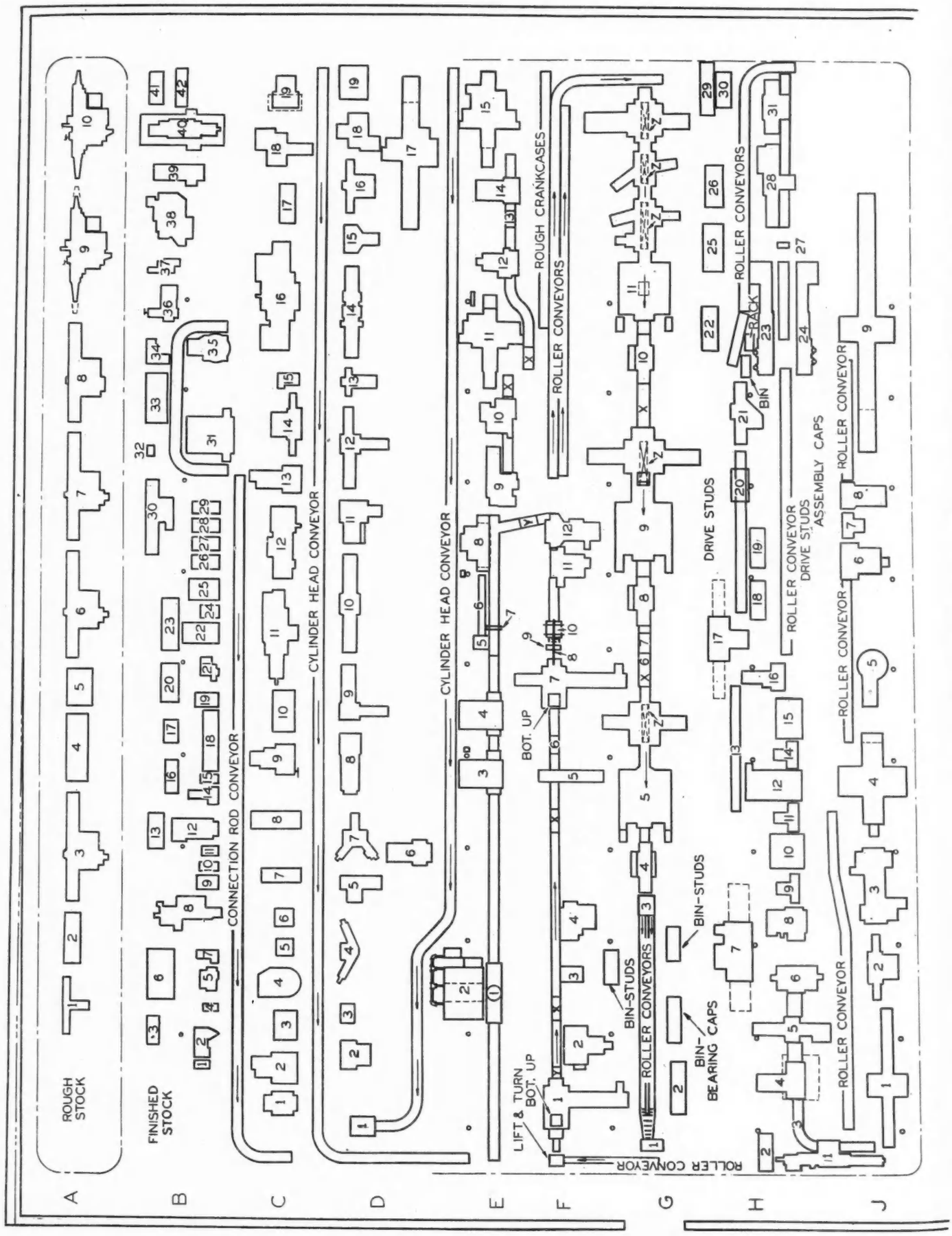
**ETCH** sleeve bore sizes, **WASH,** and **BLOW OUT** all chips
Special Alvey-Ferguson wash machine. Push button control

**INSPECT**
Electro-limit gages for crankshaft bore

mistiming. Interspersed between these three machines are automatic turnaround and chip unloading devices which require no attention. Also interspersed are three automatic washing machines which are timed in conjunction with the automatic transfer machines.

At various stations on these three machines automatic suction devices are located, which remove chips from the crankcase, carry the chips to the roof of the building, and remove them from the roof by gravity conveyor to one common unloading spot outside the building. This prolongs the life of the machines, eliminates untidiness in handling chips, and produces some savings in costs.

Camshaft and crankshaft bores and oil pump bores are bored simultaneously on a roughing and finishing machine which permits their relationships to one another to be maintained accurately for precision results. Cylinder bores are finish-bored on an angular-type Ex-Cell-O precision boring machine, on which each spindle is driven individually by belt drive. These


ROUGH STOCK
FINISHED STOCK
CONNECTION ROD CONVEYOR
CYLINDER HEAD CONVEYOR
CYLINDER HEAD CONVEYOR
ROUGH CRANKCASES
ROLLER CONVEYORS
ROLLER CONVEYOR
DRIVE STUDS
ASSEMBLY CAPS
ROLLER CONVEYORS
RACK
BIN
ROLLER CONVEYOR
ROLLER CONVEYOR
DRIVE STUDS
BOT. UP
LIFT & TURN BOT. UP
ROLLER CONVEYORS
BIN-STUDS
BIN-BEARING CAPS
BIN-STUDS
ROLLER CONVEYOR
A
B
C
D
E
F
G
H
J

# Floor Plan and Machine Tool Locations

X—Quarter Turn
Y—Gate
Z—Chip Chute

### Row A

1. Air press
2. Lathe
3. Norton Type C
4. American lathe
5. Lees Bradner
6. Norton Type C
7. Norton grinder
8. Landis bearing grinder
9. Norton pin grinder
10. Landis pin grinder

### Row B

1. Wash
2. Snyder connecting rod balancer
3. Wash tank
4. Bearingize
5. Ex-Cell-O
6. Schraner honing machine
7. Colonial press
8. Heald Sizematic internal grinder
9. Baker
10. Demagnetize
11. Wash tank
12. Blanchard
13. Tinius Olsen checker
14. Barnes
15. Baush
16. Grinder
17. Grinder
18. Bur and assembly bench
19. Colonial broach
20. Tinius Olsen balancer
21. Toledo hand mill
22. Baush tapper
23. Snyder horizontal drill
25. Barnes drill press
26. Leland-Gifford
27. Leland-Gifford
28. Leland-Gifford
29. Norton grinder
30. Leland-Gifford
31. Oilgear broach
32. Heat gears
33. Lees Bradner thread mill
34. Drill press
35. Barnes multi-drill
36. Kearney & Trecker
37. Kent Owens
38. Snyder—coolant tank
39. Barnes
40. Rockford flange drills
41. Magnaflux
42. Demagnetizer

### Row C

1. Natco finished bore
2. Natco
3. Oilgear press
4. Ingersoll rotary mill
5. Water test
6. Water test
7. Carlton
8. Carlton
9. Natco
10. Barnes 1-way driller
11. Defiance—drill and tap stud holes
12. Natco 3-decker combination drill
13. Natco
14. Milwaukee mill
15. Barnes
16. Natco 3-decker
17. Carlton radial drill
18. Cincinnati milling machine
19. Barnes

### Row D

1. Wash tank
2. Oilgear—press valves
3. Water test
4. Natco angle driller
5. Natco
6. Natco
7. Snyder Angular Driller
8. Natco 1-way—2 deck
9. Natco
10. Greenlee 2-way boring machine—nozzle holes
11. Natco 3-way tapper—manifold side and top
12. Natco 3-way driller—manifold side and top
13. Kearney & Trecker
14. Natco—drill top and bottom
15. Natco
16. Kearney & Trecker milling machine
17. Ingersoll milling machine
18. Cincinnati milling machine
19. Ingersoll rotary milling machine

### Row E

1. Turn table
2. Washing machine
3. Barnes honer—top up
4. Barnes honer—top up
5. Logan press
6. Sleeve rack
7. Air press
8. Ingersoll—mill top
9. Fitchburg—mill wick grooves one side
10. Fitchburg—straddle mill, bottom up
11. Newton—mill ends, on side
12. Moline—rough bore, top up
13. Tumbler
14. Natco—drill and ream locating holes bottom up
15. Newton—mill top and bottom on side

### Row F

1. Greenlee semi bore cam crank and pump
2. Natco—finish ream valve tappet holes, bottom up
3. Baker—straddle face center bearing
4. Cincinnati—mill pump, pad on end
5. Logan-press-in cam bearings
6. Tumbler
7. Greenlee—finish bore cam crank and pump
8. Overhead hoist
9. Reaming stand
10. Tumbler
11. Moline—semi-air sleeve bore
12. Ex-Cell-O-finish sleeve bores

### Row G

1. Baush nut runner
2. Radial
3. Tumbler
4. Wash machine
5. Greenlee-tap sides top up
6. Turn and tumble
7. Water test
8. Wash machine
9. Greenlee—tap front and rear bottom up
10. Wash machine
11. Greenlee—drill and tap top and bottom on side

### Row H

1. Rockford 2-way-drill oil gallery hole
2. American radial
3. Water test
4. Rockford angular hole driller
5. Rockford—drill sides
6. Natco—tap sides
7. Hobart washer
8. Rockford—drill top
9. Tumbler
10. Natco—tap top
11. Tumbler
12. Defiance—drill bottom
13. Press in cam bearings and ream
14. Tumbler
15. Natco—tap bottom
16. Natco—drill bottom 6 cylinder only
17. Defiance—ream sleeve bores
18. Carlton radial
19. Carlton radial
20. Line ream tappet guide hole
21. Ingersoll—mill finish top
22. Carlton radial
23. Rockford boring machine—finish bore cam and crank
24. Rockford boring machine—finish bore cam and crank
25. Carlton radial
26. Carlton radial
27. Reaming fixture
28. Defiance 2-way-drill ends
29. Carlton radial
30. Fixture for 6 cylinder crankcases
31. Natco—tap ends

### Row J

1. Ingersoll—wick groove pump pad
2. Milwaukee mill
3. Fitchburg mill—straddle mill center bearing and notch
4. Fitchburg mill—straddle mill ends
5. Rockford boring bar
6. Barnes 5-spindle—sleeve bores
7. Tumbler
8. Natco—2 locating holes
9. Ingersoll mill



work independently of the hydraulic traverse of the machine.

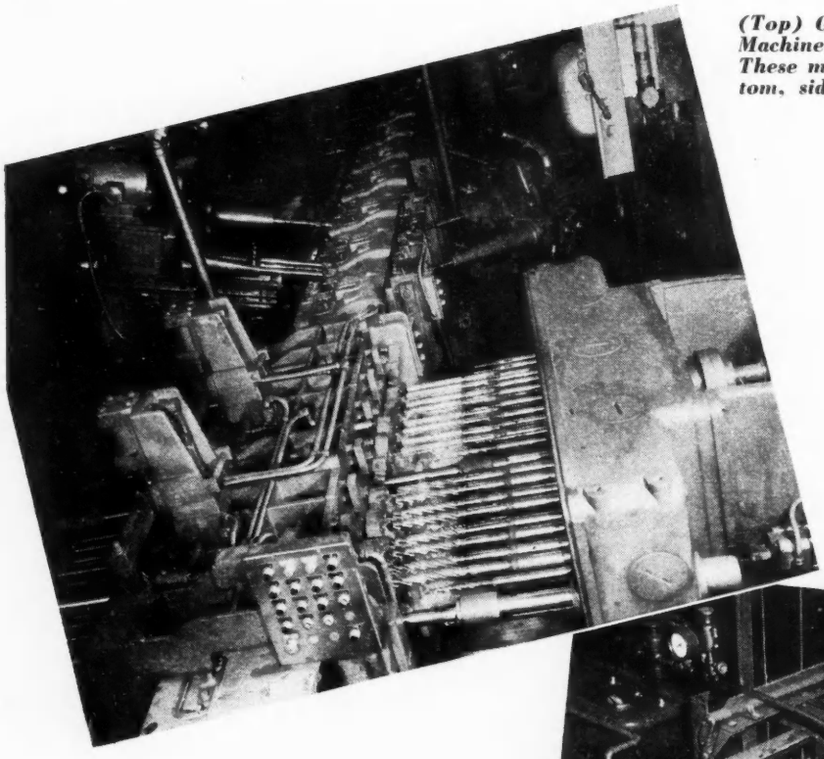
All machines mentioned on the crankcase line are automatic cycle, push button control models with adequate safety devices. Throughout the line, no manual lifting, clamping, or trucking is performed. At no time is it necessary for a crankcase to be removed from a conveyor. All inspection work is also done on a conveyor.

### *Crankshaft Line*

On the crankshaft line all shafts are handled on a 500-ft. endless overhead conveyor, which makes a complete circuit of the machines on the line. The conveyor cradles carry six crankshafts each. No trucking is done.

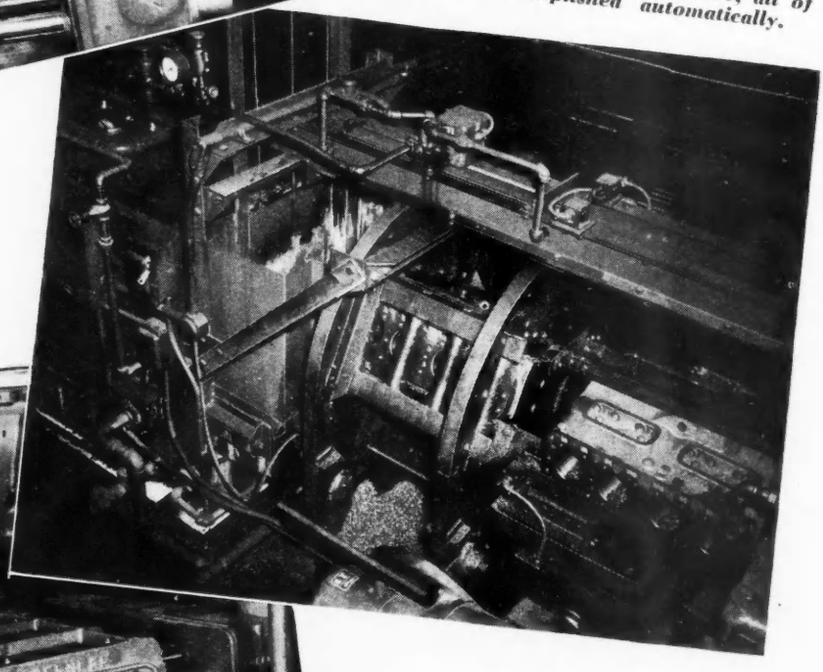
The crankshafts are Tocco-hardened, and the latest type of Norton grinding equipment is used in grinding both the line and pin bearings. These machines are of specially sturdy construction and will maintain tolerances close enough to finish-grind the line and pin bearings to within 0.0003 in. A Tinius Olsen crankshaft-balancing machine is used for both static and dynamic balancing.

Unique machine on the crankshaft line is an automatic Snyder drilling machine which drills, counterbores, reams, and taps flange holes. On the other end, the machine drills and reams two diametrically opposite holes in the stud end. This is a four-position machine with a lateral automatic index from front to

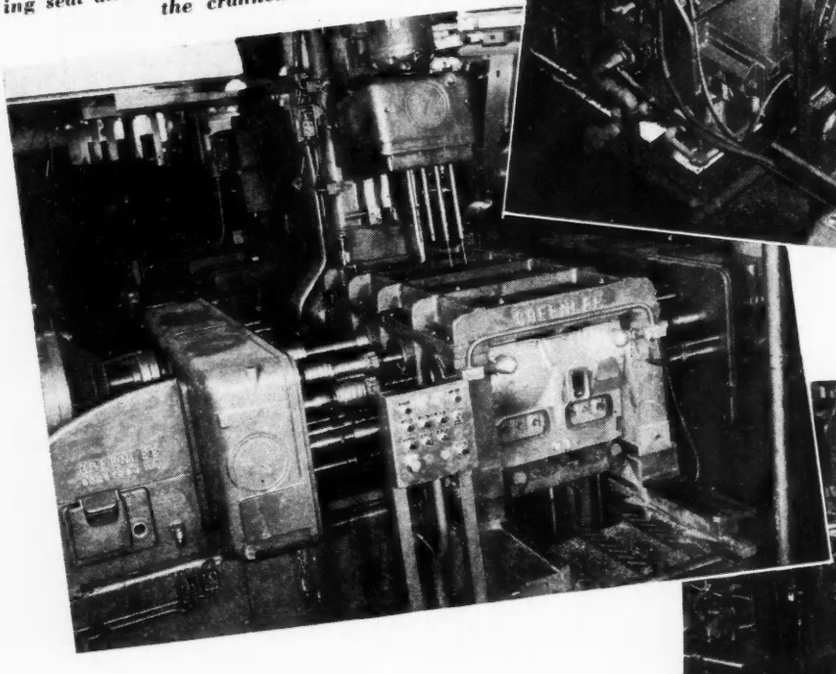


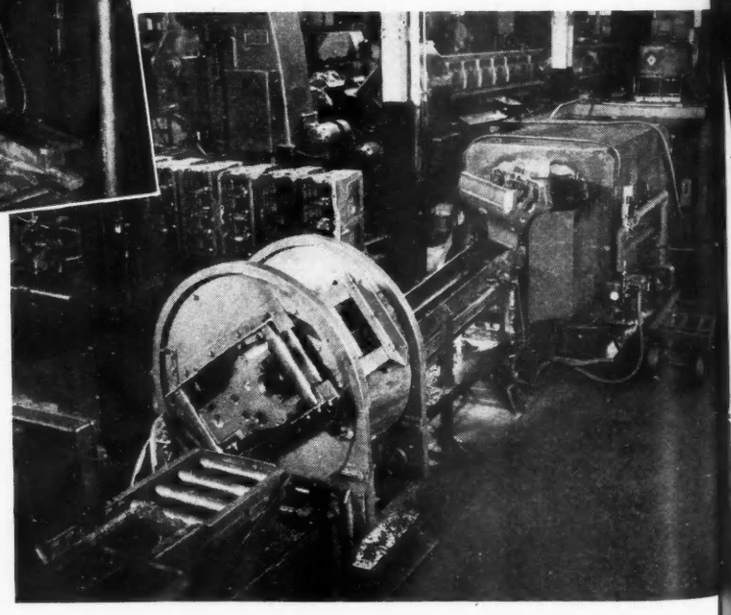
*(Top) Greenlee Horizontal Special Drilling Machine. (One in a battery of three.) These machines drill all the holes, top, bottom, sides and ends on the crankcases in one operation.*

*(Below) "Roll-over" device developed by Milwaukee Works. This device, which is located after the first Greenlee tapping machine, is one of three of various designs in the Greenlee crankcase drilling and tapping machine line. The crankcase is pushed into the "Roll-over" by pusher or transfer bar of the first Greenlee unit. The device then makes a three-quarter turn, the chips which are still in the cylinder sleeve bore drop into the chip pan and an overhead pusher which is part of the "Rollover" device pushes the crankcase into the washing machine, all of which is accomplished automatically.*



*(Below) The second Greenlee horizontal special drilling machine. This machine rough bores the camshaft bore, main bearing seat and drills all holes in both ends of the crankcase.*



*(Right) (Crankcase raising, turning and roll-over device developed by Milwaukee Works.) The picture shows a crankcase coming out of the washing machine after the second Greenlee tapping machine, where both ends of the crankcase are tapped. An elevator raises the crankcase to the proper height of the gravity conveyor, then makes a quarter turn, and a pusher pushes the crankcase on to the gravity conveyor where the crankcase rolls into another "Roll-over" device which makes a half turn, all of which is accomplished automatically, and the crankcase is ready for the third unit of the Greenlee line.*

# Connecting Rod and Cap Routing

OPERATION AND EQUIPMENT

**BROACH** sides of large bore and small end of rod and sides of cap. (One rod and one cap completed in each cycle of machine)
Oilgear 30-ton, double-slide, vertical surface-broaching machine with shuttle table and automatic clamping device

**DRILL, BORE** and **REAM** piston pin hole
Barnes multiple-spindle drill, with rotary indexing table. Push button control

**BROACH** pad, clearance on back joint face and half round hole of rod and half round hole in cap. (One rod and one cap completed in each cycle of machine)
Oilgear 30-ton double-slide vertial surface-broaching machine, with shuttle table and automatic clamping device

**CHAMFER** both ends of wrist pin hole
Leland-Gifford single-spindle drill press. Manual control

**DRILL** oil hole half way through from crank end
Leland-Gifford deep hole driller, hydraulic feed. Push button control

**DRILL** oil hole half way from pin end
Leland-Gifford deep hole driller, hydraulic feed. Push button control

BURR wrist pin boss and joint face. Bench

**DRILL** and **COUNTERBORE** cap screw hples in rod and **DRILL** and **SPOT-FACE** cap screw holes in cap
Barnes multiple-drill press, equipped with rotary indexing table. Automatic push button control

**MILL** bearing liner notch in both rod and cap. Toledo hand mill

**TAP** cap screw holes in rod
Baush special horizontal multiple tapping machine

**FINISH-BROACH** joint face on both rod and cap (One rod and one cap completed in each cycle of machine)
Colonial hydraulic single-slide vertical broaching machine. Lever control

**FILE BURR** from joint face corners and **SCRAPE BURR** from bolt holes both cap and rod. Bench

**WEIGH** and **MATCH** cap and rod
Exact weight scale

**ASSEMBLE** cap to rod
Baush nut runner. Automatic control

**GRIND** both sides of crank end
24-in. Blanchard surface grinder

**DEMAGNATIZE**
Demagnatizer

**TIGHTEN** cap screws to proper tension
Williams torque wrench

**REAM** crankshaft bore
Baker single-spindle drill press. Push button control

**CHAMFER** both sides of crankshaft bore
Barnes single-spindle drill press

**FINISH-GRIND** crankshaft bore to size and **CHECK** on amplifier gauge
Heald Sizematic internal grinder. Automatic control

**WASH** in oleum spirits. **BLOW OUT, PRESS IN,** and **BURNISH** piston pin bushing
Colonial press with push button control

**PRECISION-BORE** bushing to size
Ex-Cell-O single-spindle boring machine

**BEARINGIZE** piston pin bushing. **CHECK** size and paint size color
Bearingizer machine

**BALANCE MILL** for balance and remove milling burr
Snyder double-end milling machine. Equipped with balancing scale mounted on mill

**WASH** and clean out oil hole
Wash tank

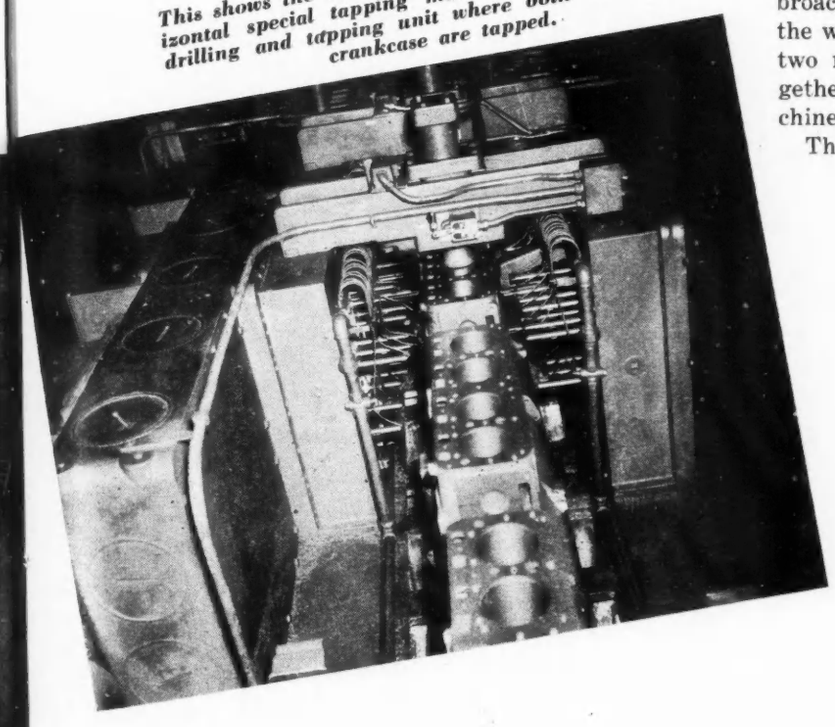
**INSPECT**

rear, with automatic return to starting position when all the described operations have been completed.

All main and pin bearings are polished on a Schraner hydraulic polishing machine which is so flexible that it handles five different crankshafts. The inspector's test on this machine is made by the use of a flat steel gage block, upon which a slight trace of Prussian blue is placed. After contact with the block, the crankshaft must show a trace of blue throughout the entire length of the bearing being checked.

Periodic checks are made on a Profilometer for smoothness because of the excessive loads imposed upon this Diesel engine.

*This shows the rear end of the third Greenlee horizontal special tapping machine in the crankcase drilling and tapping unit where both sides of the crankcase are tapped.*



### *Connecting-Rod Line*

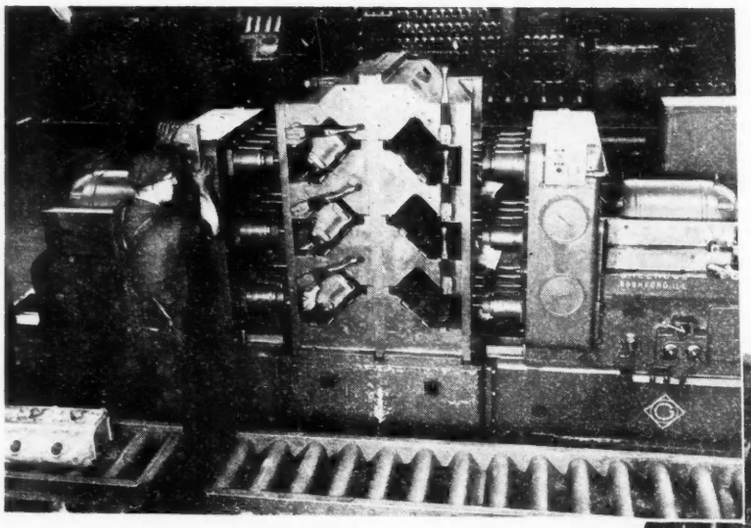
The first operation on the connecting-rod line is broaching the two sides of the crank pin, two sides of the wrist pin, the half-hole, the caps, contact face and two mortise joints which hold the cap and rod together, and the back side of the rod, which is machined so that it may clear through the cylinder bores.

The equipment used is a vertical twin-ram, 40-ton Oilgear surface broaching machine with two fixtures, having a shuttle motion in and out in sequence with two rams. The machine has no manual clamping device. All pieces are automatically clamped.

The crank bore is finish-ground on a Heald Gage-Matic machine which eliminates the possibility of a bell-mouthed bore.

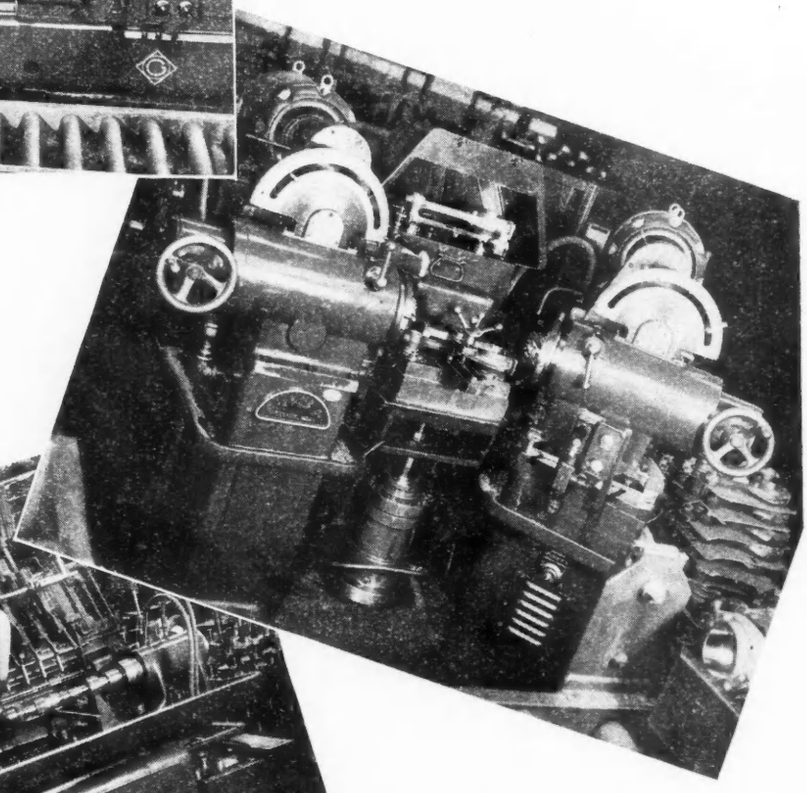
The distance between the two mortised joints on the cap contact faces is held to a total tolerance of 0.0005 in. The oil hole between the wrist pin and crank bore is drilled on a Leland Gifford drill press which is notable for a hydraulic unit which returns the drill to starting position automatically when the drill becomes loaded with chips.

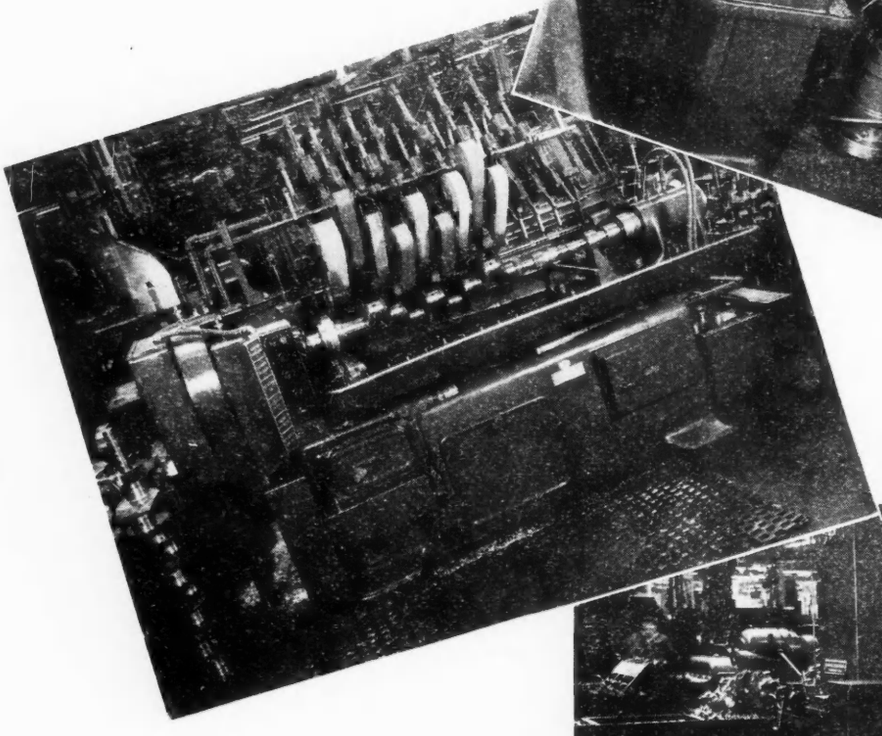
The wrist pin hole is diamond bored on a two-spindle Ex-Cell-O diamond-boring machine.



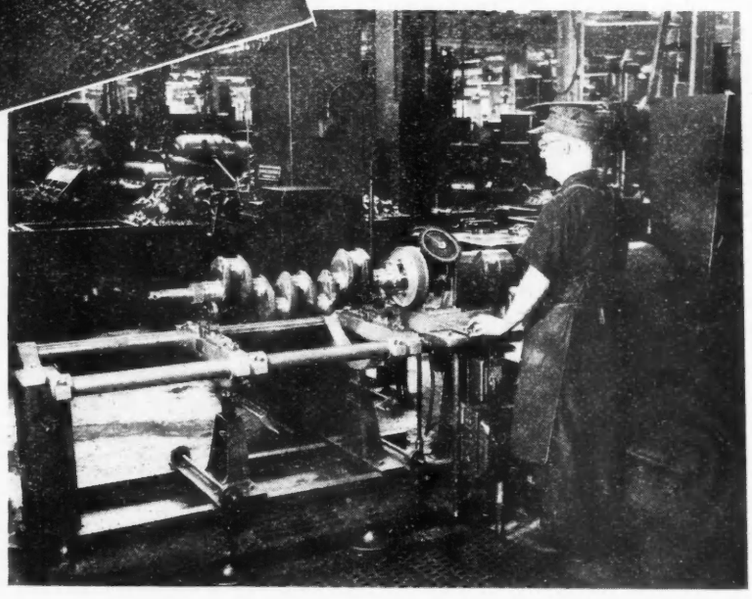
*(Top) Rough, semi and finish bore the fuel injection nozzle bores in TD-9 Diesel motor cylinder heads on a Greenlee two way horizontal drilling and boring machine. The fixture for holding the cylinder heads is designed for the TD-9 head on the left side and the TD-6 head on the right side, and the right hand head is tooled up for the TD-6 cylinder head.*

*(Right) Balancing both ends of Diesel motor connecting rods on a Snyder connecting rod balancing machine. The connecting rods are held to a very close limit. The total variation in weight of four connecting rods in the Diesel motor is held to within 2/10 of an ounce.*





*(Below) Balancing a Diesel motor crankshaft on a Tinius Olsen Static Dynamic Crankshaft Balancing Machine.*



*(Above) Lapping the main and connecting rod bearings of all 4 and 6-cylinder Diesel motor crankshafts after grinding on a heavy duty Shraner hydraulic crankshaft balancing machine.*

# Cylinder Head Routing

| OPERATION AND EQUIPMENT |
|---|
| **ANNEAL**<br>Hagan gas fired, pusher-type furnace |
| **SANDBLAST**<br>Pangborn Roto Blast sandblasting machine |
| **SPRAY** with sealer<br>Spray booth |
| **STRADDLE-MILL** top and bottom<br>Special Ingersoll drum-type milling machine<br>Continuous operation, push button control |
| **BORE** (4) starter valve holes, combination |
| **DRILL** and **REAM** (2) locating holes, **COUNTERBORE** (2) welch plug holes<br>Barnes multi-spindle vertical boring machine. Push button control |
| **MILL** manifold pad<br>Cincinnati horizontal milling machine<br>Push button control |
| **MILL** water pump pad and rear pad<br>Milwaukee horizontal milling machine<br>Push button control |
| **MILL** rocker arm shaft bracket pads<br>Milwaukee Simplex milling machine with vertical head. Push button control |
| **DRILL** (4) holes at 45 deg. in nozzle bores, **DRILL** (4) holes through starter valve throats<br>Natco multi-spindle vertical drilling machine. Manual control |
| **DRILL** (18) cylinder head stud holes halfway, **DRILL** (10) rocker shaft bracket stud holes in top, **DRILL** (3) pipe tap holes in top, **ROUGH-BORE** valve spring seat with (4) starter valves, **DRILL** (16) cylinder head stud holes through, **DRILL** (4) starter valve guide holes through, drill 6 water holes in bottom<br>Special Natco 2-way horizontal multiple drill. Push button control |
| **MILL** slot in top<br>No. 3B Milwaukee mill |
| **DRILL** (10) manifold stud holes. Combination **DRILL** and **COUNTERBORE** (4) spark plug holes, **DRILL** (4) pipe plug holes in manifold side |
| **DRILL** (1) pipe plug hole in nozzle side, **DRILL** (1) pipe plug hole and (2) cap screw holes in water pump pad<br>Special Natco 3-way horizontal multiple drill. Push button control |

| OPERATION AND EQUIPMENT |
|---|
| **TAP** (10) manifold stud holes, **TAP** (4) spark plug holes, **TAP** (4) pipe plug holes in manifold side, **TAP** (2) cap screw holes and (1) pipe hole in water pump pad, **TAP** (10) rocker shaft bracket stud holes, **TAP** (3) pipe tap holes in top<br>Special Natco 3-way horizontal and vertical multiple tapper. Push button control |
| Rough **SEMI-FINISH-BORE** and **CHAMFER** (4) nozzle bores<br>Special Greenlee 2-way horizontal stud spindle boring machine. 3-deck fixture equipped with safety limit switches. Push button control |
| **DRILL, COUNTERBORE** and **TAP** (8) nozzle stud holes<br>Defiance 2-way horizontal multiple drill and tapper. Push button control |
| **FORM RADIUS** at (4) nozzle bores in bottom of head<br>W. F. & John Barnes 1-way horizontal boring machine. Push button control |
| **FINISH-REAM** hole in (4) nozzle bores<br>Electric drill on conveyor |
| **FINISH-BORE** (4) starter valve spring seats |
| **SPOT-FACE** nut seats of (18) stud holes |
| **SPOT-FACE** and **CHAMFER** (4) intake-valve guide holes and (4) exhaust-valve guide holes |
| **DRILL** (4) cap screw holes in rear end<br>Special Natco 2-way horizontal multiple drill. Push button control. |
| Combination **SEMI-REAM** valve guide hole and **ROUGH-BORE** throat and seat of (4) exhaust and (4) intake valves. Combination **SEMI-REAM** valve guide hole and |

| OPERATION AND EQUIPMENT |
|---|
| **SEMI-BORE** throat and seat of (4) starter valves. Combination **FINISH-REAM** valve guide holes and **SEMI-BORE** throat and seat of (4) exhaust and (4) intake valves. **FINISH-REAM** valve guide hole of (4) starter valves<br>Natco 1-way horizontal multiple boring machine. Push button control |
| **SIZE-REAM** (8) intake and exhaust-valve guide holes and (4) starter-valve guide holes<br>Air motor on conveyor |
| Combination **DRILL, REAM** and **COUNTER-BORE** (4) water circulating holes at 50 deg. **FINISH-REAM** trip lever mechanism mounting hole in spark plug side. Drill (1) oil hole through at 30 deg.<br>Snyder 3-way horizontal multiple drill<br>Push button control |
| **TAP** (4) standard pipe tap holes at 50 deg. |
| **TAP** (1) standard pipe tap hole in nozzel side, **TAP** (4) cap screw holes in rear end<br>Natco 3-way horizontal multiple tapper<br>Push button control |
| **HAND CHAMFER** (4) starter-valve guide holes Conveyor |
| **DRIVE** in (4) water circulating tubes by hand |
| **DRILL** (4) holes through (4) tubes. **BURR** inside of (4) tubes with hand tool<br>Conveyor, electric drill |
| **DRILL** (1) oil hole at 33 deg. from bottom |
| **DRILL** (1) oil hole at 30 deg. from top<br>Natco 2-way horizontal drill. Push button control |
| **WHITE LEAD** and **ASSEMBLE** (4) pipe plugs in 50 deg. angular holes |
| **WATER TEST** und r 60-lb. pressure and **INSPECT** for leaks<br>Special water test stand and fixture equipped with air clamping |
| **FINISH-MILL** crankcase contact face<br>Ingersoll one-spindle vertical miller-rotary table. Continuous operation |
| **PRESS IN** (4) exhaust-valve guides, (4) intake-valve guides, and (4) starter-valve guides |
| **BROACH** and **BURNISH** (4) exhaust, (4) intake, and (4) starter-valve guides<br>Oilgear 35-ton vertical hydraulic press equipped with electric signal system to indicate maximum and minimum pressure on each valve guide |
| **FINISH-BORE** throat and seat of (4) exhaust, (4) intake, and (4) starter valves<br>Natco 3-AH vertical multiple boring machine. Push button control |
| **BREAK** all sharp **EDGES** at starter exhaust and intake-valve holes<br>Conveyor |
| **WASH** and **BLOW OUT** with air<br>Wash tank equipped with air hoist |
| **INSPECT** |
| **GRIND** (4) starter-valve seats and check for run-out<br>Hall single-spindle valve-seat grinder |
| **GRIND** (4) intake and (4) exhaust-valve seats and check for run-out and load wash machine<br>Hall single-spindle valve-seat grinder |
| **WASH**<br>Niagara washing machine |
| **BLOW OUT** all over and **ASSEMBLE** pipe plug in water pump pad<br>Bench |
| **DRIVE** (2) Welch plugs in bottom side of head<br>Bench |
| **ASSEMBLE** (8) nozzle body studs to cylinder head. Thor stud setter. Bench |
| **ASSEMBLE** manifold studs and 5 water jacket pipe plugs<br>Thor stud setter. Bench |
| **ASSEMBLE** rocker shaft bracket studs and **ASSEMBLE** breather pipe and fittings<br>Thor stud setter. Bench. |
| **INSPECT** |

Balancing pads are provided at both the wrist pin and crank pin ends of the rod, and the rod is balanced to within two-tenths of an ounce-inch on a rise-and-fall Snyder automatic-balancing machine. The connecting rods are thus held within balance from the beginning of production, an important factor in reducing future service problems.

All connecting rods are carefully inspected in the forge shop for grain flow, trim marks and scratches, and each rod is Magnafluxed to guard against fatigue.

### *Cylinder Head Line*

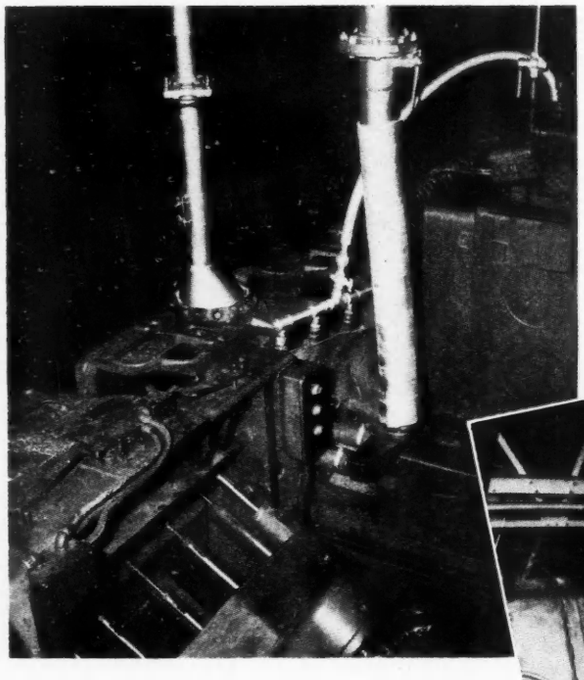
Cylinder heads are made of alloy iron with a high chrome content and are carefully checked for cracks,

# Crankshaft Routing

| OPERATION AND EQUIPMENT |
|---|
| **STRAIGHTEN** and **GRIND** sharp edges from checks and throws and from grease pocket at end of shaft<br>Hannifin straightening press equipped with special straightening fixture<br>Flexible shaft grinder |
| **GRIND** No. 3 main bearing to size and **SEMI-FINISH-GRIND** No. 1 main bearing<br>16 in. Norton hydraulic external grinder |
| **FINISH-FACE** flywheel flange<br>American engine lathe |
| **MILL** oil groove<br>Lees Bradner thread mill |
| **FINISH-GRIND** Nos. 1, 2, 4 and 5 main bearings and spacing, and **GRIND** outside diameter of flywheel flange<br>16-in. Norton hydraulic external grinder |
| **GRIND** gear fit and pulley fit diameters and **GRIND** face of No. 1 main bearing to length and **FILE** sharp edges<br>16-in. Norton hydraulic external grinder |
| **GRIND** 4 pin bearings to size and width<br>21 x 62-in. Norton hydyraulically operated crank pin grinder |
| **MAGNAFLUX** and **INSPECT**<br>Magnaflux machine |
| **DRILL, CHAMFER** and **TAP** (4) flywheel bolt holes and |

| OPERATION AND EQUIPMENT |
|---|
| **DRILL** and **REAM** (2) dowel holes in flywheel flange. **DRILL** and **REAM** starting crank pin hole and **DRILL** and **TAP** starting pin lock screw hole in stub end<br>Snyder 3-station horizontal and vertical multiple drill and tap machine<br>Equipped with automatic horizontal indexing fixture |
| **MILL** 3 Woodruff keyways<br>Kent-Owens hand mill |
| **MILL** thread on stub end. **FILE BURRS** from keyways and from starting pin holes and **ASSEMBLE** Woodruff keys<br>Lees Bradner thread mill |
| **ASSEMBLE** crankshaft timing gear on crankshaft<br>Gas furnace and conveyors |
| **GRIND** outside diameter of oil slinger |
| **FILE** sharp **EDGES** and **POLISH** outside diameter<br>14-in. Norton external grinder. Manual control |
| **BALANCE** and **DRILL** for balance<br>Tinius Olsen crankshaft balancer<br>Snyder horizontal drill |
| **POLISH** all main and pin bearings<br>Schraner crankshaft polisher. Hydraulically controlled |
| **WASH** and place on skids for inspection<br>Wash tank |
| **INSPECT** |

***(Below) Part of the chip exhaust system installed after the first Greenlee drilling operation. This system, which was developed at Milwaukee Works, extracts all the drilling chips from the crankcase by means of a vacuum and delivers them into a receptacle located on the roof of the building, from which they are deposited into trucks and then disposed of.***

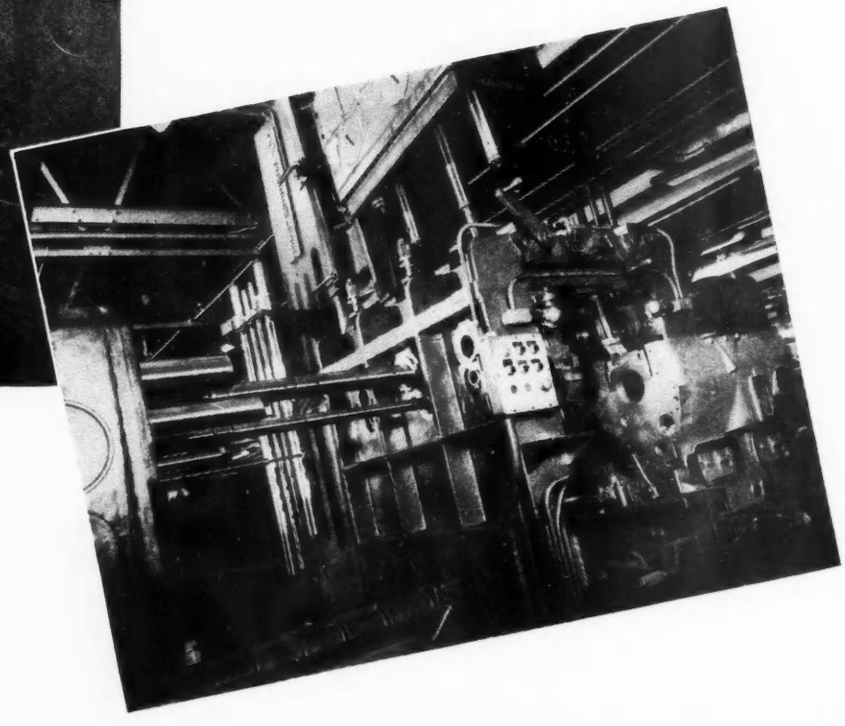


flaws, or blow holes, both before and during the process of machining.

Tops and bottoms are rough and finish-milled on a special Ingersoll drum-type milling machine, and all holes, regardless of angularity or position, are done on multiple equipment. This equipment is of a unit head type which is flexible enough for any new future product designs.

An interesting machine on the cylinder head line is a special Oilgear broaching machine which presses in all valve guides simultaneously and then broaches and burnishes the inside of the valve guide stem. The broaches fall through into a wooden container beneath the machine. Each spindle is equipped with an electric eye which flashes a warning to the operator if the pressures are either too high or too low.

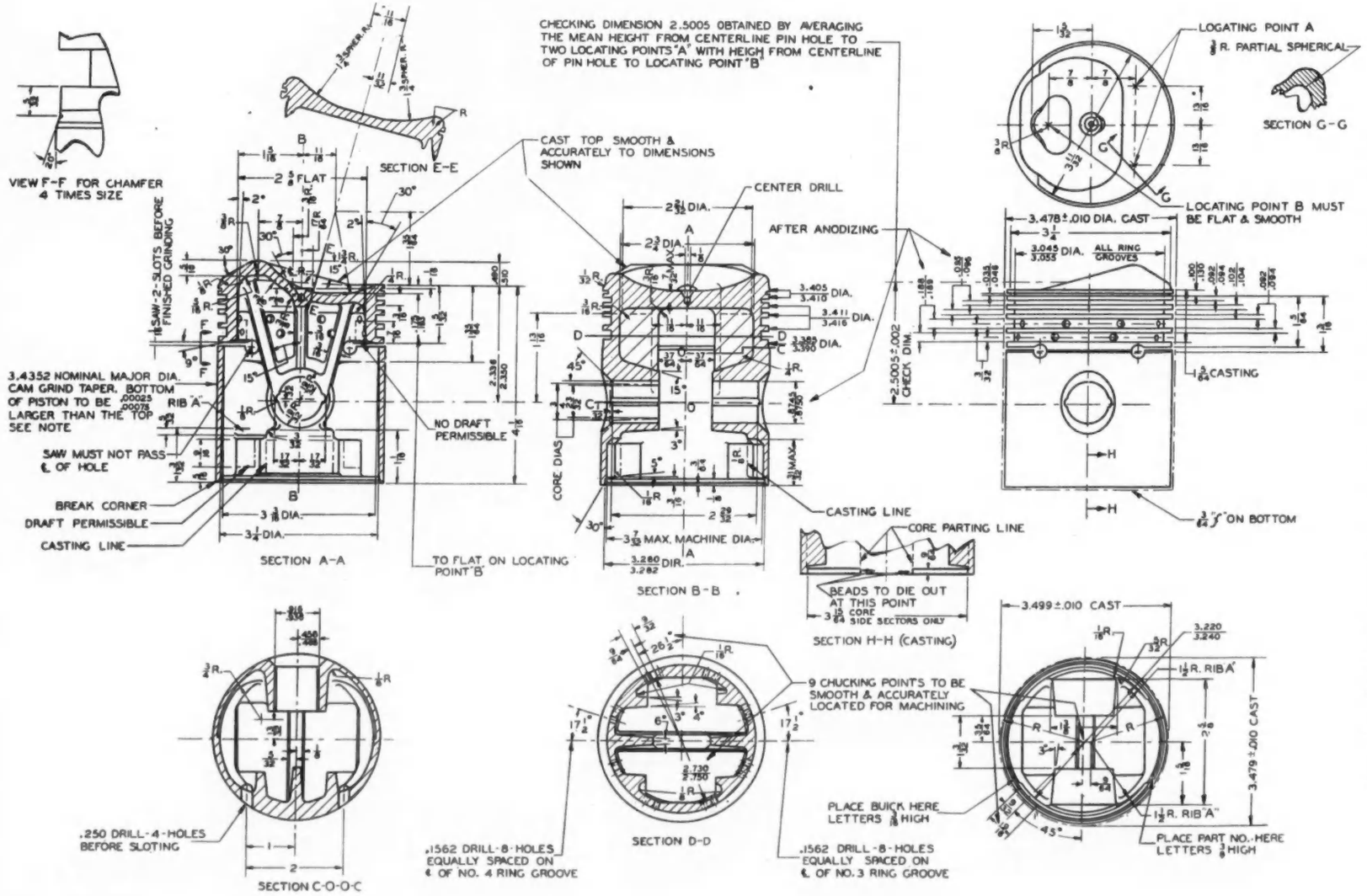
(*Turn to page* 614, *please*)



***(Right) A close-up view of a three way Greenlee drilling and boring machine—finish boring the main and connecting rod bearings, reaming the oil pump bore and finish reaming dowel holes on both ends of the crankcase. The view also shows how these special machines are arranged and equipped to machine three different size crankcases.***

# MANUFACTURING CONTROLS ON BUICK PISTONS

***Here is another contribution for the Engineering file. On this and the following page are copies of the drawings and chart used in the Buick plant in the production of pistons***




Cam grind piston to contour shown on 1317902. Finished piston must weigh 1.121 lb. ± .0039 lb. (1.77 grams).

Break all corners of ring grooves not to exceed .010R.

Anodize to minimum average thickness of .0003 after finish grinding.

Piston pin hole must be square with central axis within .002 in length of piston and intersect central axis within .005.

Heat treat: Alcoa—A132—T-551.

Physical properties: tensile strength (lbs./sq. in.) 30,000 min.

Brinell hardness 90-120.

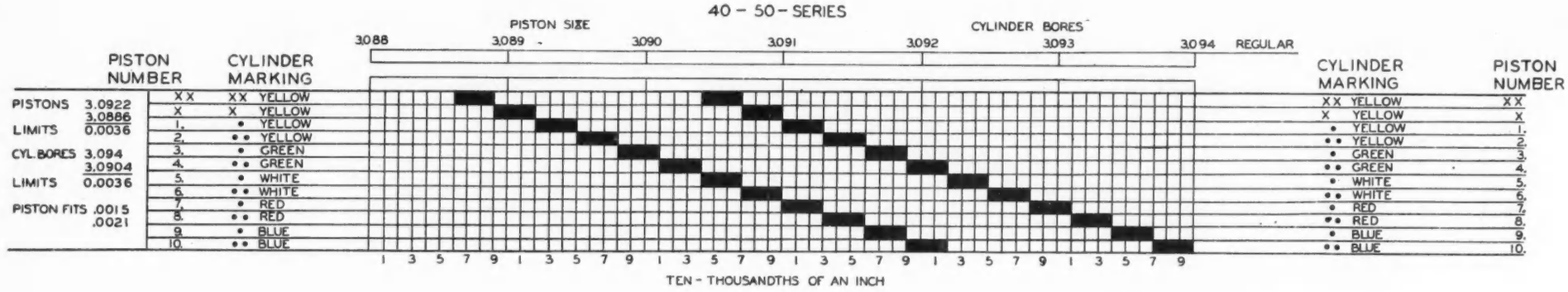
Pistons to be measured at major dia. as shown and selected to fit cylinders as measured by paddle gages per chart No. 1293568. (See next page.)

Piston pins to be fitted per chart No. 1293568.

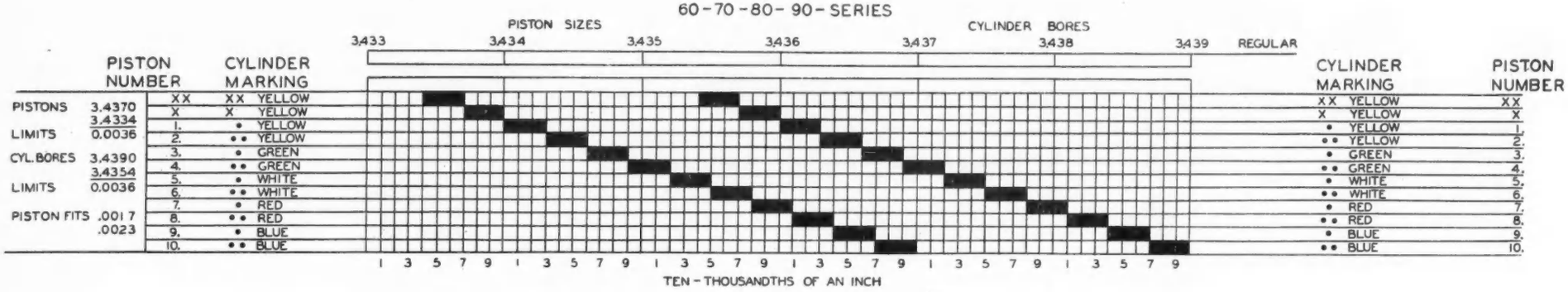
# MANUFACTURING CONTROLS ON BUICK PISTONS

***See preceding page for detail drawings***

## 40 – 50 – SERIES




## 60 – 70 – 80 – 90 – SERIES




Piston to be selected for size by measuring with an indicating gage at the points shown on the piston drawings.

Sizes to be taken as an average of the readings on both sides of the vertical saw slots.

Pistons should not be colder than 70° F. when measured.

Barrels to be selected for size by measuring with paddle gages at an angle of 90° F. with the axis of the block and using the smallest diameter between the top and center of the bore.

Paddle gages to be set at the high limit of the indicated size.

All barrels should be within the specified limits of .001 max. taper and .001 max. out of round.

Piston pin to fit .0003 to .0004 loose with pin and piston at 70° F.

These sizes include allowances for out of round and taper above or below .002 tolerance as specified on cylinder bore.

# NEWS OF THE INDUSTRY

## Automotive Committee Studies Manufacturing for Airplanes

### *Carlton Gets Leave of Absence to Head Group Seeking Cooperation of Automobile and Parts Plants in Program*

Rapid expansion of aircraft engine production in the National Defense emergency is graphically illustrated by the experience of the Allison Division of General Motors Corp. Prior to July, total production for the division was fewer than 100 engines. In the four months from July through October, output was stepped up to a total of 647 1000-h.p. engines. July production was 73 units, August 65, September 223 and October 286. Production is expected to reach 400 engines per month by December, and a year hence, when the present expansion program is completed, it is expected to be at a rate of 1000 engines monthly.

At present Allison is the only producer of liquid-cooled aircraft engines in the U. S., and thus the sole supplier of the Army for its swift pursuit planes such as the Bell Aircobra P-39, the Curtiss P-40 and the twin-engined Lockheed P-38. However, Packard expects to be in production by next August on the 1100-h.p. Rolls-Royce Merlin liquid-cooled engine, while Ford is experimenting with a V-12 liquid-coled engine of Ford design, and Tucker Aircraft Corp., a new Detroit firm, is working on an eight-cylinder liquid-cooled job designed by Harry Miller, racing car designer.

The Allison property at Indianapolis was acquired by GM in 1929, but it continued as a small experimental plant until 1937, when the first Allison liquid-cooled engine passed the necessary War Dept. tests. The first expansion of the Allison plant was begun in June, 1939, following a War Dept. order for 969 engines. An order from the French government was signed Dec. 8, 1939, and one from the British government followed on May 25, 1940.

The first expansion following the original War Dept. order was completed in November, 1939, but two more expansions have been necessary since then. Production a year ago was only about five engines per month, but this has been stepped up progressively to the present rate of 286. Buildings and machinery to operate the plant at half its ultimate capacity are expected to be completed and installed by Jan. 15, 1941, according to C. E. Wilson, GM acting president.

A year ago Allison employed only 900 men. The present payrolls list 7,200 men at the Indianapolis plant and an additional 1,750 working on parts at the Cadillac Division in Detroit. At peak production, Indianapolis will employ 10,000 workers and Cadillac 3,000 on Allison parts. The Indianapolis plant now occupies 1,000,000 square feet of floor space, compared to 90,000 a year ago. In addition, 140,000 square feet are being used for Allison production at the Cadillac Division.

Clarence C. Carlton, who had been serving as temporary director, has been named permanent director of the Automotive Committee for Air Defense. He has been granted a leave of absence from the Motor Wheel Corp., Lansing, where he is a vice president, but will continue as president of the Automotive Parts & Equipment Mfg., Inc. Carlton will be assisted by William J. Cronin, secretary of the manufacturers committee of the AMA.

Five hundred representatives of manufacturing concerns already have visited the committee headquarters in the Graham-Paige administration bldg. in Dearborn. There they have inspected 400 sample parts, forgings and castings as well as numerous blueprints. The committee's staff is studying aviation construction methods and analyzing existing automotive facilities with the aim of coordinating new sources of supply for plane parts and sub-assemblies.

In addition to William S. Knudsen's request for fuselage and wing parts for 12,000 long-range, multi-engined bombers, the Glenn L. Martin Co. has asked automotive plants to assist in supplying 33 aluminum alloy forgings and castings for 930 B-26 bombers identical with the 8,000 bombers that are part of Knudsen's original request. There also is the possibility that the automobile industry will be asked to double the original request of the De-

(*Continued on page* 610)

## CALENDAR

**Conventions and Meetings**

American Society of Mechanical Engineers, Annual Meeting, New York City ..... Dec. 2-6
Aeronautical Chamber of Commerce of America, Inc., Annual Meeting, New York ..... Dec. 5
National Association of Manufacturers, Annual Meeting, New York... Dec. 9-13
SAE Annual Meeting, Detroit, Jan. 6-10, 1941
National Automobile Dealers Association, Convention, Pittsburgh, Pa. Jan. 20-23, 1941

**Shows at Home and Abroad**

Automotive Service Industries Show, Chicago ..... Dec. 9-14
Machine & Tool Progress Exhibition, Detroit ..... Mar. 24-29, 1941

## Triple Damages Issue Raised in Tire Suit

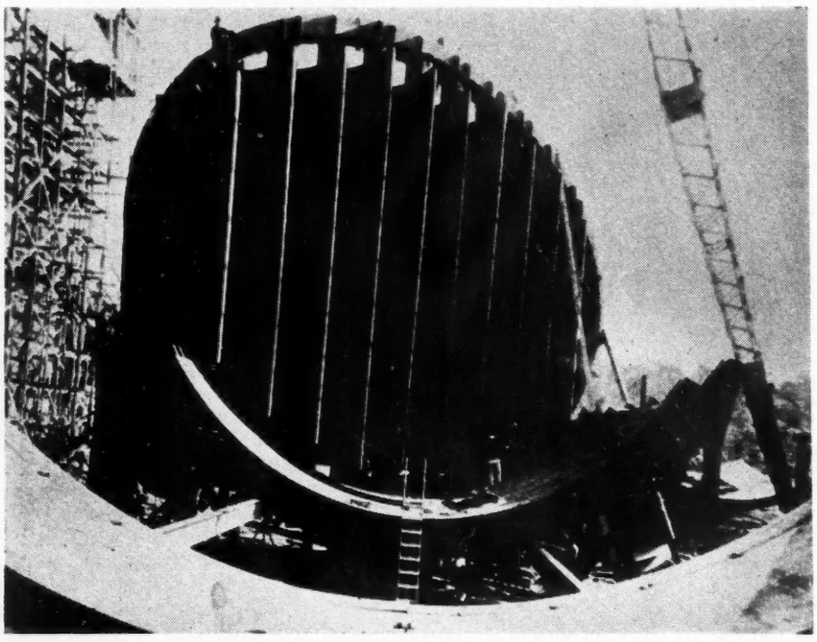
Whether the Government can maintain a triple damage suit under the Sherman anti-trust law will be determined by the Supreme Court when it hands down a decision in the case involving 17 rubber tire manufacturers who are alleged by the Government to have conspired to fix prices "identical to the penny."

Representing the first time in the 50 years of the act's existence that the Government has claimed this punitive right, the case takes on added importance in view of large-scale Government purchases under the national defense program, and because of the complaint against identical bidding frequently registered by various Government agencies.

Attorneys for the companies involved were quoted as saying that the litigation does not affect the right to punish violators of the anti-trust law by means of fine, imprisonment or injunction but whether triple damages can be secured in addition.

A Federal Circuit Court in New York had previously dismissed the suit to collect $1,053,474 in triple damages from the tire manufacturers, holding that the Federal Government was not

(*Continued on page* 610)



*Army's Wright Field at Dayton, Ohio, is getting a new wind tunnel with a 40 ft. diameter, through which a custom-built Westinghouse motor will push air up to 400 m.p.h. Scale models with a 15 foot wing spread can be accommodated.*

# CIO Asks U. S. to Withhold Defense Orders from Ford

***Resolution Directed at Dearborn Manufacturer Would Link Defense Contracts with Wagner Act***

Carrying their fight against the non-union Ford Motor Co. to the floor of the CIO annual convention at Atlantic City last month, delegates from the UAW-CIO pushed the adoption of a resolution demanding that National Defense contracts be denied to companies violating the National Labor Relations Act. The Ford Co. was the target because the UAW-CIO has launched a new drive to organize the only large automobile manufacturer which is not unionized.

The Ford Motor Co. has filed a 21-page petition with the Sixth U. S. Circuit Court of Appeals at Cincinnati asking that portions of a NLRB order, upheld by that tribunal Oct. 8, be set aside. The NLRB enforcement decree which was upheld Oct. 8 ordered the Ford Motor Co. to cease and desist from interfering with union activities of its employes, to reinstate 23 discharged workers with full pay and to post notices in the Rouge plant that the order has been complied with. However, it also gave Henry Ford the right to disseminate his views upon labor problems among his employes. The case probably will be carried to the U. S. Supreme Court.

Roy J. Thomas, president of the UAW-CIO, criticized the government for awarding a $122,323,020 order for aircraft engines to the Ford Motor Co. on Nov. 6. Demanding guarantees of collective bargaining from firms with National Defense contracts, Thomas told the CIO convention, "We do not want the government to organize the Ford Motor Co. for us. We will take care of that. But we do expect the government to make Ford obey the laws the same as every citizen of the coun-

(*Continued on page* 605)

## Minimizes Necessity For Priority on Tires

W. F. Bloor, assistant to the president, Goodyear Tire & Rubber Co., Akron, Ohio, reported to the National Defense Advisory Committee on Nov. 13 that the tire manufacturing industry is now operating at 75 per cent of capacity and that it sees no need for increasing its capacity or instituting priorities.

Appearing at a conference called by the commission's consumer division to study wholesale problems in relation to the defense program, Mr. Bloor referred briefly to what he described as a five-point program under which joint efforts of the Government and the industry are aimed at stabilizing the price of rubber at 18 to 20 cents; standardizing types of tires; and developing rubber sources in South America as a long-term proposition.

## Safety Signal Group Sponsors Standards

Under the "voluntary recorded standards" procedure of the Bureau of Standards of the U. S. Department of Commerce, nine groups of manufacturers of automotive safety-lighting equipment sold in the replacement market have agreed to formal commercial standards, which have been gazetted by the Bureau of Standards, and will become operative Jan. 1, 1941.

Details of the agreed-upon standards are contained in a series of pamphlets, available for 5 cents each, from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The official designations of the standards, and their code numbers, follow:

CS80-41. Direction - Signal - Systems, electric (other than semaphore type; for commercial and other vehicles).

CS81-41. Lamps, electric; adverse-weather (for vehicles).

CS82-41. Spotlamps, electric; inner-controlled (for vehicles).

CS83-41. Lamps, electric; clearance, identification, and marker (for vehicles).

CS84-41. Lamps, electric tail (for vehicles).

CS85-41. Lamps, electric; license-plate (for vehicles).

CS86-41. Lamps, electric; stop (for vehicles).

CS87-41. Lanterns, electric; warning, red.

CS88-41. Flares; liquid burning.

## Packard, Ford Training Mechanics for Navy

Setting up of naval barracks at the Ford Motor Co. Rouge plant on the banks of the River Rouge as a training station for U. S. Navy mechanics and machinists is planned under the terms of an offer made by Henry Ford and approved by Col. Frank Knox, secretary of the Navy. Facilities of the Ford machine shops, tools and other equipment will be made available to the Navy recruits. The first class will consist of 500 recruits, but this eventually will be doubled and the Navy hopes to train 1000 recruits as mechanics and machinists every three months.

Packard Motor Car Co. already is giving a three week course in its marine engine division to eight-man classes. These are composed of U. S. Navy seamen and officers who will man the surface torpedo boats which are powered by the new 1350-hp. Packard marine engine. The classes give the Navy personnel a complete working knowledge of the engine.

### Perfect Circle Sets Record

Perfect Circle Co. reports that for the 11 months ending with November, 1940, it made and sold more piston rings than in any similar period of the company's history.

# Highway Needs for Defense Outlined at AAA Meeting

### *Carmody Sees Need for 2900 Miles of Access Roads, Urges Support of Development Road Transport Means*

Centering around national defense topics, the thirty-eighth annual meeting of the American Automobile Association held in Washington on Nov. 14-15, was told in a message from President Roosevelt that "there is need for some improvements in our system of roads and concentration on connecting these with centers of mobilization and defense production." Read by AAA President Thomas A. Henry of Detroit, who was reelected, the Chief Executive's message said that the AAA "can give great assistance in the coordination of normal and military highway use." About 400 delegates of automobile clubs throughout the country attended the convention.

*Surrounding perennial-president Thomas P. Henry at the AAA's annual meeting are (l. to r.) Senor Don Francisco Najera, the Mexican Ambassador, (Mr. Henry), Adolf A. Berle, Jr., assistant Secretary of State, and Colon Eloy Alfaro, Ecuadorian Ambassador.*

Federal Works Administrator John M. Carbody pointed out that a total of 2900 miles of access roads to military and naval establishments are immediately needed as a part of the broad national defense highway program and urged AAA to throw its wholehearted support behind the effort to develop highway transportation facilities. Similar recommendations were made by the AAA's highway and legislative committee in its annual report submitted by Col. Sidney D. Waldon, Detroit committee chairman. The report declared that highway needs for national defense can be met without wholesale construction not warranted by the volume of civilian traffic. A report by the National Association of Motor Bus Operators charged that lack of uniformity in state laws governing the size and weight of vehicles constitute transportation bottlenecks and are hampering efforts to provide better facilities for users of public transportation. AAA's Committee on Roadside Development and Control submitted a report through its chairman, William A. Stinchcomb, Cleveland, urging nationwide adoption of legislative measures designed to protect roadsides in the interest of health, decent appearance and general public welfare.

Assistant Secretary of State Adolf A. Berle suggested that AAA draft a travel code to guide Americans in their responsibility when visiting foreign countries and paid tribute to the "peace system" of Americans, which were said to have given "more peace to more people over a larger area and for a longer period of time than any other system."

Naming the petroleum industry, housing, food, milk, optical glass and other commodities which he charged are sold at artificially high prices in a restricted market, Assistant Attorney General Thurman W. Arnold asked for

(*Continued on page* 604)

## MEN . . . . . .

**Olds Promotes Three**

The appointment of two assistant chief engineers and a director of styling has been announced by **Harold T. Youngren**, chief engineer of Oldsmobile.

**Jack F. Wolfram**, experimental engineer, has been named assistant chief engineer in charge of engine, transmission and the axle design and development division at Oldsmobile.

**Maurice A. Thorne**, chassis engineer, has been named assistant chief engineer in charge of body, chassis, electrical, accessory groups and office administration.

**John Oswald**, body engineer, has been appointed Oldsmobile's director of styling with responsibilities for car appearance and appointments.

**Gordon R. Walker** has been named vice-president and sales manager of the Walker Mfg. Co., Racine, Wis., following the resignation of **Malcolm McCormick** from the same position.

**Harry T. Woolson**, executive engineer, Chrysler Corp., has been elected vice-chairman of the Engineers' Council for Professional Development.

**Henry Ford** was awarded the gold medal of the Holland Society of New York because of his "eminence in scientific manufacturing" at the society's fifty-sixth annual dinner on Nov. 14 in New York.

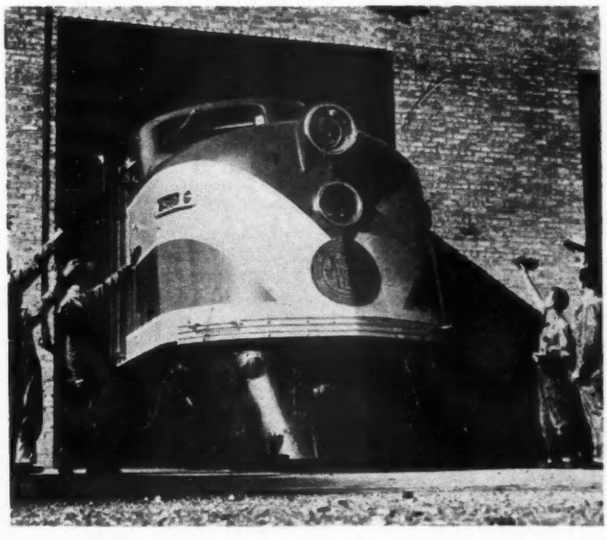
**Bernard M. Bickford** has been named manager of Plymouth's Evansville, Ind., branch plant. He formerly was assistant general superintendent of the Plymouth main plant at Detroit and has been with the company since 1931.

**Frank H. Griffin**, head of the Cadillac sales-service department for seven years, has been appointed sales promotion manager for the newly created

(*Continued on page* 611)

### *Beep!*

***First of 18 new Diesel-Electric Streamliners for the Atlantic Coast Line railroad is shown leaving the LaGrange, Ill., shops of the Electromotive Division of General Motors.***



## Highway Needs

(*Continued from page* 603)

prompt removal of restraints of trade and price-fixing methods in major industries as a means of clearing the decks for efficient national defense production efforts. Blame for the alleged trade restraints and artificially high prices was placed in some instances on the labor unions, in some on the manufacturers and in some on the distributors.

Recommendations of the Highway and Legislative Committee follow:

First, building up of the priority system of major highways to the standards required for efficient movement of mobile military equipment.

Second, construction of access roads to naval and military establishments.

Third, provision for roads to new or expanded industrial plants engaged in national defense work or ancillary activities.

Fourth, building of express highways into and through congested metropolitan areas on the basis of the highway planning surveys, eventually connecting these roads with the interregional system.

The report said that problems of hemisphere defense have brought new recognition of the importance of completing the all-American highway which would stretch from Alaska to Argentina. Gratification was expressed that, in addition to engineering and survey assistance provided under a special Congressional appropriation, the Government has granted through the Export-Import Bank, special highway-building loans totaling $12,400,000 to Costa Rica, Ecuador, Nicaragua, Panama and Paraguay. The report explained that the all-American Highway embraced two separate, but complementary highway projects, the Pan-American Highway and Alaskan International Highway, whose completion, it was stated, would provide the Western Hemisphere with something it has long needed—a route connecting all the American Republics.

Mr. Carmody estimated that approximately $194,000,000 will be needed to finance access roads. He stated that Public Roads Administration data on the condition of the strategic system reveal the main weakness in its 75,000 miles, nearly all of which was said to coincide with the more extensive Federal-aid highway system.

"These data show that 4000 miles of the strategic system are less than 18 ft. in width, and 14,000 miles are deficient in surface strength," said Mr. Carmody. "Furthermore, 2400 bridges fall below the standard for strength, and 500 additional bridges do not meet the 18-ft. standard of width or the 12½-ft. standard for clearance, or are deficient in both respects."

"So while our strategic system of highways is in reasonably satisfactory condition, it is not fully adequate and needs a great deal of work done on it. Under normal conditions, this work of modernizing the network designated by the War Department as strategically important would be done gradually during the next several years. Under present conditions, these improvements may have to be rushed to completion in a much shorter time."

The financial committee recommended that in view of the complexities of the problem, the exigencies of national defense, and the moratorium features of defense legislation, that attempts to draft model legislation for regulation of finance practices be postponed.

AAA officers were elected as follows:

President, Thos. P. Henry, Detroit, Mich., president, American Automobile Association; first vice-president, John H. Wright, Jamestown, N. Y., director, New York State Automobile Association; second vice-president, John R. Bentley, Cleveland, Ohio, president, Ohio State Automobile Association; third vice-president, Howard W. Hughes, Washington, Pa., president, Pennsylvania Motor Federation; fourth vice-president, D. H. Lewis, Buffalo, N. Y., president, New York State Automobile Association; fifth vice-president, Sam W. Burchiel, Providence, R. I., president, Automobile Club of Rhode Island; sixth vice-president, Arthur H. Breed, Sr., Oakland, Cal., director, California State Automobile Association; seventh vice-president, R. R. Reynolds, Asheville, N. C., United States Senator from North Carolina and vice-president Carolina Motor Club; secretary, John L. Young, Cleveland, Ohio, managing director, Cleveland Automobile Club; treasurer, Corcoran Thom, Washington, D. C., president, American Security and Trust Co.

## CIO-Ford

(*Continued from page* 602)

try."

In his annual report to the convention, John L. Lewis, retiring president, said, "Workers in the plants of Henry Ford must be organized. At the present time wages paid in Ford plants are below those paid by other large automobile manufacturing concerns. Headquarters have been established for the drive and the workers in the Ford Plants are having the message of this great movement brought to them. . . . . Ford must be brought to realize there is an American way—and that way is organization of the workers and sound, sincere collective bargaining."

Sidney Hillman, labor member of the National Defense Advisory Commission, defended the national defense program against such attacks. He said he knew of no violations by defense contract holders of the Walsh-Healy Act or the Wages and Hours Act, but he admitted there was some question about enforcement of the Wagner Labor Relations Act. He begged for patience in correcting these situations and pointed out that even the CIO had not been successful in all its objectives. The CIO has been in existence five years, he said, and the defense commission only five months.

### Hillman Wants to Meet Ford

Hillman told the convention that he intends to request a meeting with Ford Co. officials in the near future "to get their labor policy in line with the National Defense Commission labor policy."

The 10 delegates of the UAW-CIO, representing 412,000 votes, supported Philip Murray in his election to succeed Lewis as CIO president. Two other unions surpassed the UAW-CIO in voting strength.

In an effort to forestall strikes in National Defense industries like that at the Vultee Aircraft Corp. at Los Angeles, Hillman announced the establishment of 25 labor zones for the nation, with a "troubleshooter" in charge of each. Hillman said the "troubleshooters" would provide experienced leadership to aid the younger unions.

Hillman stated that no notice of intention to strike was filed before the workers at the Vultee plant walked out Nov. 16. He laid this to the inexperience of the union leadership.

The Vultee strike was authorized Nov. 15 by Thomas after negotiations between the company and the UAW-CIO broke down over the basic wage scale. The union asked a basic wage of 75 cents an hour, such as prevails in the automobile industry, compared to the 50-cent scale in effect when the strike was called. The employes reportedly voted for the strike 2252 to 52.

The UAW-CIO claims a majority among Vultee's 3700 production workers. After nearly a week of negotiations, a compromise was worked out on wages, providing for 55 cents an hour during the first month's employment, 57½ cents for the next 60 days and 62½ cents thereafter. However, the negotiations became deadlocked when the union refused a "no-strike" provision in the two-year contract. The wage raises would have totaled $1,262,606 annually under the compromise reached. The Vultee company has $84,000,000 in aircraft orders from Great Britain and the U. S. and the strike threatened to curtail the training of army pilots at Randolph Field, Tex., due to a shortage of training planes which Vultee manufactures.

Major Sidney Simpson, representing the War Department, Lyman Sisley and E. H. Fitzgerald, ace Federal conciliators; Wyndham Mortimer, Walter Smethurst and L. H. Michener, representing the UAW-CIO; and Robert W. Millar, Vultee president, participated in the negotiations.

A jurisdictional dispute at the Wilcox-Rich Division plant of the Eaton Mfg. Co. at Saginaw, Mich., threatened to tie up three of the largest manufacturers of aircraft engines in the U. S. if it continued. The plant is the sole supplier for key aircraft parts as well as making automobile parts. Members of the UAW-CIO called the strike Nov. 12 in an effort to obtain bargaining rights. They charged the UAW-

(*Continued on page* 606)

## CIO–Ford

(*Continued from page* 605)

AFL, which holds a collective bargaining contract and claims a majority of the plant's 1200 workers, is a company union. Limited picketing was permitted at the plant by Saginaw police, although Judge William J. Martin issued an injunction prohibiting strikers from interfering with UAW-AFL members going to work. There was some violence at the plant gates and 12 arrests were made. Production at the plant, which had been working three shifts, was greatly curtailed.

Picketing at the Windsor, Ont., plant of the Chrysler Corp. is not tolerated when the country is at war, 46 members of the UAW-CIO learned Nov. 19. They were fined $25 each, with the option of a month in jail, under the Defense of Canada Act which prohibits picketing of defense plants. The men walked out in a dispute over promotion of a foreman in which violation of seniority rights was charged.

Trial of 14 members of the UAW-CIO, arrested Nov. 1 for violating Dearborn's anti-handbill ordinance by passing out union pamphlets at the gates of the Ford Motor Co., has been postponed until Dec. 1.

General Motors and the UAW-CIO must seek a new umpire under the terms of their contract since the resignation of Dr. Harry A. Millis, who had been named Oct. 10 after several months' discussion. Doctor Millis resigned to become chairman of the NLRB. In his most important decision as umpire, he found for the union in requiring foremen to submit written reports on the disposition of grievance slips turned in to them by the shop committee. The cases arose at the Chevrolet Gear and Axle Division, Detroit.

Negotiations were due to open Nov. 25 between the Chrysler Corp. and the UAW-CIO on amending the basic contract signed Nov. 30, 1939. A vacation bonus plan similar to that of GM, a blanket wage increase for 50,000 hourly rated workers and a union shop clause were among the important demands asked by the union.



## Benefits Seen in Sub-Contracting

The National Defense Advisory Commission, laying increased emphasis on the sub-contracting phase of the defense program, has released a breakdown of contracts already let by one major aircraft company showing that products ordered ranged from armor plate from Pennsylvania, ball and roller bearings from Connecticut to anchors and exhaust manifolds from California. Defense commission officials pointed to the list as illustrative of what they described as "widespread results" expected from the sub-contract program.

As one phase of the expanding sub-contracting technique, Sidney Hillman, labor representative on the defense commission, is conducting studies of areas where unemployment has been greatest in recent years. Aim of the program is to find localities where parts can be manufactured and sometimes sub-assembled through the facilities of idle machinery and manpower.

The results of the investigation, to be made public, are expected by labor representatives on the commission to enable industry to benefit from practices by manufacturers who have pooled their equipment and experience. In Milwaukee, for example, firms have been handicapped by inability to acquire new machine tools, according to Mr. Hillman. His information is that these companies are now cooperating closely with other companies which have idle tools but no defense orders. Officials expressed the hope that such a system of team work and local initiative will be brought increasingly into play as demand for defense commodities is constantly enlarged.

The other important arm of sub-contracting program centers around Donald M. Nelson, who was recently appointed director of small business activities. By decentralizing its functions through the regional offices of the Federal Reserve System, the efforts of Mr. Nelson's division are expected to make credit for expansion more easily available to sub-contractors.

# Japanese Push Expansion of Automotive Activities

### *Pressure is Greater on American Interests in Nippon as Commercial Delegations Bag New Markets*

Several employes of Ford's and GM's branch plants in Japan have left for home, but refuse to admit that their departure has any connection with the State Department's recent advice to move out of the Far East. Business has been on the downgrade for several years and Ford, at least, had made up its mind to wind up for good, long before the present crisis became obvious. The company's plant may be moved to the Philippine Islands. Its disposal in Japan has been frustrated by the Japanese government's inability to guarantee the transfer of the proceeds in foreign currency. In addition to frozen accounts of some size, Ford has about Y2 million worth of Japanese war bonds among assets not likely to survive an American-Japanese crisis. GM has not yet announced a definite plan.

Once gone, the American firms are not likely ever to return. Japan already produces beyond her own small requirements, and the neighboring markets in Manchuria and China have been quietly appropriated. Japan is already looking farther afield. Curious Frenchmen, in Indo-China, unable anyhow to import their beloved Citroens and Peugeots, and impressed by the performance of Japan's hoodless C.O.E. trucks in the new "inspectorate," have placed trial orders for Nipponese automobiles. Latest news is that a party dispatched by the Nissan Automobile Company to investigate business possibilities in Thailand (formerly Siam) has made arrangements for establishment of assembling, service and repair shops in the kingdom. There may be strategical considerations back of this plan, but this is likely to make Japanese competition in business all the more effective.

Japan has announced that her international trade statistics will no longer be released for publication (publication of output statistics was suspended in 1937), and the latest issue of the trade returns, covering the first seven months of 1940, is therefore of some historical interest. In this period Japan exported 3913 cars and chassis, as compared with 2699 and 1089 in the coresponding periods of 1939 and 1938. Shipments of parts reached a value of Y22.8 million, as compared with Y13.9 and Y8.9

(*Continued on page* 608)

## CENSORED

*An exclusive feature prepared by the London correspondent of* AUTOMOTIVE INDUSTRIES, *M. W. Bourdon.*

* * *

Subject to a fixed limit of "lost time" per pay week, compensation is to be paid to "time workers" at the normal time (or overtime) rate for periods of enforced idleness during air raids, with the proviso that where time is lost on this account a worker shall, if required, make up in the same or the following week the time so lost up to a maximum of eight hours per week, with payment at the full appropriate rate. Any worker refusing without good reason to make up time lost will not be entitled to the compensatory payments.

* * *

The ban upon the sale of new cars to the public in general imposed in July is to be continued, but arrangements have been made for a small number (about 400, half of them foreign) to become available to persons engaged in work of vital national importance, providing they can convince the Ministry of Transport that a license to purchase new cars should be granted to them.

## Monthly Motor Vehicle Production *(U. S. and Canada)*

| | PASSENGER CARS | | TRUCKS | | TOTAL MOTOR VEHICLES | |
|---|---|---|---|---|---|---|
| | 1940 | 1939 | 1940 | 1939 | 1940 | 1939 |
| January | 375,476 | 292,869 | 74,016 | 64,093 | 449,492 | 356,962 |
| February | 350,535 | 253,914 | 71,690 | 63,606 | 422,225 | 317,520 |
| March | 364,947 | 312,392 | 75,285 | 77,107 | 440,232 | 389,499 |
| April | 375,626 | 286,200 | 76,807 | 68,066 | 452,433 | 354,266 |
| May | 338,353 | 249,455 | 74,139 | 63,793 | 412,492 | 313,248 |
| June | 294,779 | 257,289 | 67,787 | 66,964 | 362,566 | 324,253 |
| July | 172,166 | 155,850 | 74,005 | 62,750 | 246,171 | 218,600 |
| August | 48,333 | 62,475 | 41,533 | 40,868 | 89,866 | 103,343 |
| September | 227,880 | 165,119 | 56,703 | 27,560 | 284,583 | 192,679 |
| October | 428,270 | 259,610 | 86,104 | 65,079 | 514,374 | 324,689 |
| 10 Months | 2,976,365 | 2,295,173 | 698,069 | 599,886 | 3,674,434 | 2,895,059 |
| November | ..... | 295,134 | ..... | 73,407 | ..... | 368,541 |
| December | ..... | 384,858 | ..... | 84,260 | ..... | 469,118 |
| Total | ..... | 2,975,165 | ..... | 757,553 | ..... | 3,732,718 |



## Japan Pushing

(*Continued from page* 607)

million. Most of these exports were consigned to Manchuria and China. The figures do not include shipments to Korea and Formosa. Whenever Japan's trade drive in the South Seas picks up momentum, one will have to look for statistical details in the trade returns of the countries of destination.

The Ministry of Commerce and Industry has decided to set standards for Diesel engines. Production will in future be limited to two capacities, 5000 and 8000 cubic centimeters. Manufacturers will be subject to no restrictions regarding the choice of injection systems, chamber construction, and cycle. Only one of the known types approaches one of these standard displacements, most models having displacements of 4398, 4771, 4960, 5320 and 6597 cubic centimeters, the exception being the Sumida R.U., which has a displacement of 7980 cubic centimeters.

The Toyota Automobile Manufacturing Company, which has been building machine tools for its own use since 1937, has decided to split off this department as a subsidiary, to be capitalized at Y8 million. A factory site covering 40,000 square yards has already been bought at Kariya, near Nagoya. A similar step toward "vertical" expansion was the recent establishment of the Y12-million Toyota Steel Manufacturing Company.

One of the last plants to be completed with pre-embargo American machine tools is the new aero-engine plant of the Kawasaki Aircraft Company at Fujie, near Kobe. Kawasaki Aircraft is one of the "big three" in the Japanese aircraft industry, the other two being Nakajima Aircraft and Mitsubishi Heavy Industries.

## Olds Names Two

S. E. Skinner, general manager, has announced two new appointments at the Olds Motor Works.

Effective at once, John Dykstra, formerly general superintendent of production, becomes assistant works manager, and Roy A. Fishel, superintendent of the six and eight motor plants, becomes night superintendent.

Mr. Dykstra served his apprenticeship as a die maker from 1914 to 1917 with the Briscoe Manufacturing Co. of Detroit, and then, after time out for the World War, during which he served overseas as a corporal in the Motor Transport Corps, was successively a tool maker, machine operator, die maker, foreman and general foreman, superintendent and assistant factory manager, with Northway Motors, Cadillac Motor Car Company and Hudson Motor Company.

He was superintendent of the Sheet Metal Division of Oldsmobile from 1934 through 1939 and became general superintendent of production in February this year.

# Census of Manufactures Shows Biennial Changes in Car Value

### *Net Average Wholesale Price of Automobiles Up $37 While Value Added by Manufacture Declines 16.3 Per Cent*

The factory value of motor vehicles, bodies, and parts made last year was $4,039,930,733, according to a preliminary report on the 1939 Census of Manufactures issued by the Bureau of the Census. The report was compiled under the direction of Thomas J. Fitzgerald, chief statistician for the Division of Manufactures.

The 1939 production value figures probably includes a certain amount of duplication, due to the fact that products of establishments engaged in the manufacture of bodies and parts are to a great extent consumed by other establishments in the industry in the manufacture of sub-assemblies and complete vehicles. The duplication has been reduced to a minimum, however, by allowing companies with two or more plants in the same city to file combined reports for such plants, the Bureau says.

Since it contains no duplication, more significance may be attached to the figure on value added by manufacture, which is obtained by subtracting cost of materials, etc., from value of products. In 1939 the value added by manufacture was $1,319,369,575.

Both items show declines from 1937. Value of products is 23.5 per cent less than the 1937 level of $5,279,696,851. Value added by manufactures is down 16.3 per cent from the 1937 total of $1,575,955,955.

The major product of the industry, of course, was passenger cars, of which the 1939 output numbered 2,822,261, with a factory value of $1,798,252,016, an average of about $642 per vehicle. This represents net wholesale selling price, including factory-installed extra equipment. It compares with $605 for 1937, when 3,847,800 passenger cars, valued at $2,296,511,131, were produced. The total value of extra equipment installed in cars produced during 1939 was $38,796,150, or slightly less than $14 per car.

Motor-vehicle bodies and parts produced in one plant for further handling in another or for sale in the replacement market were valued at $1,465,700,225 last year, compared with $2,116,647.353 in 1937.

Commercial car and truck production numbered 431,648 in 1939, compared with 602,144 in 1937, with a decline in value from $356,682,501 to $259,882,606. This amounts to a drop in average price from $616 to $602.

Output of commercial chassis increased from 226,205 to 232,903, with factory value rising from $113,223,370 to $150,923,643.

Other products of the industry last year included 4675 motorbuses, valued at $34,063,710; trailers for motor trucks and truck-tractors, worth $28,563,363, of which 26,021 were reported by number, and $5,456,138 of fire-department apparatus.

There were 1053 establishments in the industry last year, a 6.8 per cent increase over 1937. The number of salaried personnel decreased 12.5 per cent from 52,587 to 46,031, with a 2.3 per cent drop in salaries from $117,603,871 to $114,840,544.

The number of wage earners engaged primarily in manufacturing operations was 397,537, with a payroll of $645,142,599. The final report will also include the number of construction and distribution workers, and their wages.

For materials, supplies, fuel, purchased electric energy, and contract work, the industry spent last year $2,720,561,158, or 26.5 per cent less than the 1937 total of $3,703,740,896.

### Grumman Gets Army Order

Acquisition and installation of additional plant facilities to cost $3,500,000 is contemplated in a War Department contract given the Grumman Aircraft Engineering Co., Bethpage, N. Y.

## Committee Studies

(*Continued from page* 601)

fense Commission in order to supply 12,000 bombers for Great Britain. This would boost the total order to 24,000 bombers and would involve an outlay of $1,000,000,000. Congress has not yet appropriated the $500,000,000 for the original U. S. 12,000-bomber order, but is expected to do so early in the new session in January.

The problem of assembling these many parts for bombers is expected to necessitate the construction of two huge aircraft assembly plants. One of these, costing more than $20,000,000, is expected to be built in the Detroit area.

At present the Automotive Committee for Air Defense is engaged in the lengthy process of exploring aviation construction methods, their adaptation to the automotive facilities that are available and development of manufacturing plans for drawing from many plants a synchronized flow of readily assembled, matching parts. Airplane builders, military experts and automotive production men are cooperating on this problem.

Size alone would preclude automobile and truck plants from taking over this complete construction job, even if the specialized engineering involved did not compel expert aeronauti al supervision. Sub-assemblies, however, such as portions of wings, tails and ailerons, may become part of the job to lighten the strain on the rapidly expanding aviation industry and to utilize existing machinery and machine tools.

The extent to which automobile mass production methods can be employed remains to be worked out.



## Triple Damages

(*Continued from page* 601)

a "person" and was, therefore, not entitled to recover triple damages. Specifically, the circuit court held that the provisions of the Sherman Act permitting any "person" to sue for triple damages resulting from conspiracies which restrain interstate commerce did not apply to the Government.

The Supreme Court agreed on Nov. 12 to review the case.

When identical bids were received by the Treasury Department's procurement division sometime ago, the bids were thrown overboard and the Government contracted to buy its tires from Sears, Roebuck & Co. on this basis, the counsel for the tire manufacturers raised the question of whether the Government suffered any loss as a result.

## Kelsey-Hayes Purchases Land for Defense Work

Kelsey-Hayes Wheel Co. has purchased nearly 100 acres of land near Plymouth, Mich., for the erection of a plant to manufacture Colt and Browning machine guns for the British government. Funds for the construction and equipment of the plant are being provided by Great Britain. It is hoped that the plant, which will employ 2000 men, will be in production by next summer. Kelsey-Hayes already has a U. S. government order for ammunition components which it is working on at its Detroit plant.

## U.S.A. Used 50,206 Tons Crude Rubber in Month

The Rubber Manufacturers Association, Inc., estimates that rubber manufacturers in the U. S. A. consumed 50,206 long tons of crude rubber during the month of September. This represents a decrease of less than one per cent under the August consumption of 50,234 (revised) long tons, and 2.3 per cent below September, 1939, when 51,402 (revised) long tons were consumed.

### Williams Leaves I.A.E.

C. G. Williams, for many years director of the Research Station of the Institution of Automobile Engineers, has resigned in order to take up an appointment with Shell gasoline interests; Dr. E. Giffen from the King's College, London University, has been appointed in his place.

## MEN

(*Continued from page 603*)

southeastern territory. **Edward F. Korff** will succeed Griffin as manager of the sales-service department.

**William F. Wise,** president of the Republic Aircraft Products Division, Detroit, has been named executive vice-president of the Aviation Mfg. Corp. He will continue as president of Republic and also will supervise the Lycoming and Spencer Heater divisions at Williamsport, Pa.

**Donaldson Brown,** vice-chairman of General Motors Corp., has been elected to the board of the Federal Reserve Bank of New York City.

**George L. Briggs** has resigned as executive vice-president and as a director of the Wilkening Mfg. Co., Philadelphia.

**A. M Bell** has been appointed assistant manager of the Sealed Power Corp., in charge of the company's sales and manufacturing for Canada.

**D. R Donaldson** has been appointed factory manager of Transportation Engineers, Inc., Detroit. He has been a production executive in the industry for 30 years, with Packard, Murray, Briggs, etc.

**John F. Ditzell** has been appointed general sales manager of the Shafer Bearing Corp., Chicago. He was with the Stewart-Warner-Alemite Corp. as a sales executive.

**W. W. Lowther** has been named chief engineer of the Donaldson Co., Inc., succeeding **Fred R. Nohavec. John C. Enblom** has become assistant chief engineer of the company.

**Curt Saurer,** formerly automotive sales engineer, mechanical rubber division, Firestone Tire & Rubber Co., resigned recently to form the Curt Saurer Co., Detroit, Mich. This company will specialize in the sale and design of mechanical rubber parts, cooperating with manufacturing organizations in the rubber industry.

**Harry E. Evans** has been appointed manager of the Sales Promotion, Planning and Market Research Department of the Willard Storage Battery Co., Cleveland, Ohio. **Howard C. Negus** has been appointed advertising manager, and **L. G. DeMotte** is now assistant to the Renewal Sales Manager for the same company.

**M. M. "Bob" Roberts** has been named merchandising manager of the Hudson Motor Car Co. **W. A. James** has resigned as Hudson advertising and merchandising manager because of ill health. A. E. Barit, president of the company, stated that all advertising and merchandising activities would be under the supervision of **George H. Pratt,** general sales manager, and that the appointment of an advertising manager would be announced shortly.

**E. R. Perry** has been appointed executive assistant to the president of the Boeing Aircraft Co., Seattle, Wash.

**Peter J. Altman,** director of the department of aeronautical engineering at the University of Detroit, has resigned to join the Aviation Mfg. Corp. as chief of technical research.

**E. J. Hunt,** formerly general staff master mechanic for the Chrysler Corp., has been appointed operating manager in charge of the new Chrysler Tank Arsenal now under construction on the outskirts of Detroit. He has been associated with the Maxwell and later the Chrysler Corp. since 1912.

**C. E. Wolliever,** assistant personnel director of Buick, has been elected secretary of the automotive and machine shop section of the National Safety Council. Mr. Wooliever directs safety work at Buick.

**Joseph Howell** has been named to handle the General Motors Truck account for **D. P. Brother & Co.** He formerly handled sales promotion for the Oldsmobile account.

## Estimated Dealer Stocks of New Passenger Cars

| 1939 | July | August | September | October | November | December |
|---|---|---|---|---|---|---|
| Production—U. S. Domestic Market † | 142,346 | 56,245 | 155,430 | 239,150 | 272,747 | 357,712 |
| Retail Sales—U. S. ‡ | 229,873 | 166,172 | 139,222 | 236,584 | 257,398 | 274,233 |
| Change in Inventory | −87,527 | −109,927 | +16,208 | +2,566 | +15,349 | +83,479 |
| Inventory, First of Month | 295,708 | 208,181 | 98,254 | 114,462 | 117,028 | 132,377 |
| **1940** | **January** | **February** | **March** | **April** | **May** | **June** |
| Production—U. S. Domestic Market † | 348,755 | 324,555 | 341,634 | 351,814 | 315,441 | 276,949 |
| Retail Sales—U. S. ‡ | 239,509 | 236,857 | 338,153 | 353,423 | 330,521 | 350,871 |
| Change in Inventory | +109,246 | +87,698 | +3,481 | −1,609 | −15,030 | −73,922 |
| Inventory, First of Month | 215,856 | 325,102 | 412,800 | 416,281 | 414,672 | 398,592 |
| **1940 (continued)** | **July** | **August** | **September** | **October** | **November** | **December** |
| Production—U. S. Domestic Market † | 165,672 | 45,172 | 220,696 | 411,016 | ..... | ..... |
| Retail Sales—U. S. ‡ | 298,683 | 177,679 | 158,083 | 326,219 | ..... | ..... |
| Change in Inventory | −133,011 | −132,507 | +62,613 | +84,797 | ..... | ..... |
| Inventory, First of Month | 324,670 | 191,659 | 59,152 | 121,765 | 206,562 | ..... |

†—U. S. Census Bureau. ‡—Automobile Manufacturers Association.



## Steel Priorities

### *Informal System Found Satisfactory to Car Plants*

The informal priority system, under which the steel industry is now operating, comes in for little or no criticism from automotive consumers. In practice, it means that buyers in the miscellaneous steel-consuming industries, ranging all the way from hairpins to pianos, can not obtain booking of an order for three or four times their normal requirements, unless they need the steel for making an article needed for national defense and can refer to the contract documents to prove this. The needs of automobile manufacturers and of parts makers are being supplied as promptly as production facilities permit.

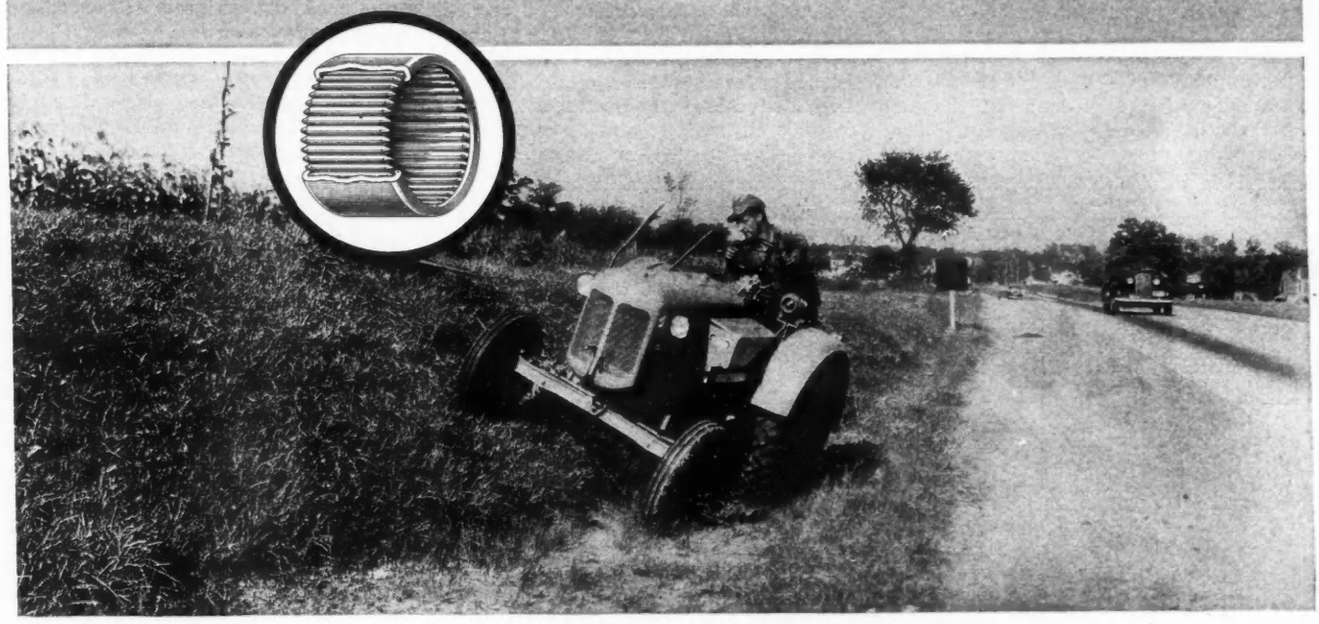
It is recognized that under a rigid priority system, production methods of steel mills would have to be altered, and this would add sharply to costs. The compromise now in operation eliminates diversion of urgently needed capacity to the making of steel for hoarding by makers of non-essentials and permits the provisioning of economically important industries, such as automobile manufacture, without impairing the flow of steel into national defense.

Deliveries are on the whole satisfactory. There is a lengthening of order book entries, but this is not due to mills falling behind in shipments, but to additional tonnages being ordered. At that, backlogs are being held to manageable proportions, especially so in the Detroit steel district. Hot rolled bars continue to come in for heavy demand. Much of this comes from automotive consumers, but pressure comes chiefly from miscellaneous buyers. The steel industry, as a whole, operates this week at a rate of 96.6 per cent of ingot capacity, which was also last week's estimate of the American Iron & Steel Institute. Aside from minor changes in scrap iron prices here or there, the market's basic structure remains unaltered. Relatively heavy accumulations of scrap in Detroit tend to keep the price received by automobile manufacturers and parts makers down.—W. C. H.

Although the high-cost copper producers in Michigan as well as in Arizona are continuing their campaign for having the National Defense Commission rescind its attitude toward copper prices and to permit the 12-cent level to be exceeded, the market takes continuance of prevailing conditions for granted, and premiums in the outside market have tapered off to negligible fractions. There has been some talk of the establishment of "stabilization pools" to smooth out temporary price bulges through the forming of a stock pile of copper and other domestic metals, but so far there has been no official pronouncement on these plans.

Consumers are showing little interest in tin offerings, although prices are the lowest in some time. November-December deliveries of Straits tin were offered early this week at 50.05 cents and spot tin could be had at 50⅛ to 50¼ cents.

# "TORRINGTON NEEDLE BEARINGS TAKE HEAVY ROTATING AND OSCILLATING LOADS EFFECTIVELY" IN CENTAUR HI-WAY MOWER



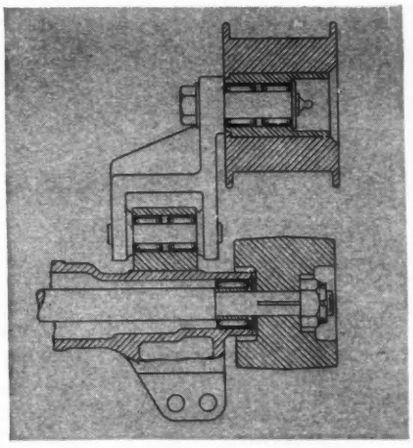
Eleven applications of the Needle Bearing help to reduce friction, increase operating efficiency and add to the service-life of this Model KM Centaur Hi-Way Mower.

SWAYING and lurching up-ditch, down-ditch, over slopes, fills and embankments—and most of the time at an acute angle—the popular Centaur Hi-Way Mower plies its job of keeping road-borders clear of weeds and other unsightly growths that mar the beauty and impair the safety of modern highways.

As can be appreciated, such rough and tumble service imposes severe strain on every component part of this motorized mowing unit. Therefore, the long service-life of the Model KM Centaur is adequate testimony to the skilled engineering construction with which it is built, and the care with which integral parts are selected.

The Torrington Needle Bearing is no exception to this rule. According to Mr. E. A. Cross, Superintendent of the Centaur Corporation, "The Needle Bearing was selected because it is economical in cost, simple to install, requires minimum space in cramped locations, retains lubrication well, and withstands heavy rotating and oscillating loads effectively.

"All told," adds Mr. Cross, "eleven applications of Torrington Needle Bearings are used on Centaur KM and RW mowing equipment. In three applications of the Needle Bearing, Torrington inner races* are used as 'bushings' to withstand heavy oscillating shock loads and have proved very efficient."



Typical of these applications is the mower drive shaft, belt tightener, pulley and bracket which illustrates the compact design permitted by Torrington Needle Bearings.

When any manufacturer selects the Needle Bearing for as many of its features as has the Centaur Corporation, there is very little that we can add. Except, perhaps, to stress its ready adaptability to product design, which frequently results in marked savings in weight, space and cost. That, plus the suggestion that *you* translate these remarkable manufacturing and operating advantages into terms of *your* product, to appreciate why so many leading manufacturers have adopted this revolutionary anti-friction development.

For further information write for Catalog No. 7. For Needle Bearings to be used in heavier service, request Booklet 103X from our associate, the Bantam Bearings Corporation, South Bend, Ind.

*Where a hardened shaft is not feasible, a Torrington hardened inner race can be supplied.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
*Makers of Needle and Ball Bearings*

New York Boston Philadelphia Detroit
Cleveland Chicago London, England

**TORRINGTON**
**NEEDLE BEARING**

# Ingenious Grouping of Machines

(*Continued from page* 598)

### *Piston Line*

The methods of machining pistons are in keeping with advanced practice. All pistons are turned on automatic lathes. The wrist pin hole is bored on an Ex-Cell-O precision boring machine. All pistons are handled on conveyors with a return conveyor underneath for empty trays.

No grinding is done on the outside diameter of the piston, but diamond turning is done on a special Sundstrand automatic lathe. The finish and smoothness are at least equal, if not superior, to the usual ground finishes.

### *Sleeve Line*

The cylinder sleeves used are hard, dry liners. The rough boring of the sleeves is performed on a vertical eight-spindle W. F. & John Barnes boring machine. Outside diameters are turned on automatic Fay lathes and are then delivered to a gas furnace which is built adjacent to and as part of the line. The sleeves are inspected for hardness in the range of 45 to 55 Rockwell "C."

After heat treat, the sleeves are not ground on the inside but instead are reamed on a battery of special Baker hydraulic drills and special equipment developed by Barber-Coleman, the reamers of which have blades of inserted Tantalum-carbide tips.

Special short, gravity-feed conveyors are placed between groups of operations so that no trucking is necessary. Sleeves run on these conveyors on their own periphery.

The piston line and sleeve line converge at a common point where pistons, pins, and sleeves are fitted.

### *Miscellaneous Parts*

Among the miscellaneous parts manufactured are oil pumps, oil pump covers, water pumps, drive pulleys, starting crank nuts and other small machine parts, as well as repair parts.

An interesting machine in use on oil pump bodies is an Ex-Cell-O trunnion horizontal multiple drilling and reaming machine. It performs every operation required on the oil pump body except centering or turning operations. No line boring or reaming is necessary after the pump body leaves this machine. It is fully automatic, governed by push button control.

Such equipment as No. 5-A and 6-A Potter and Johnstons, Heald special facing machines, new type Fay lathes, special Gisholt lathes with various speeds and feeds are used to turn a number of small machined parts. On timing gears a six-spindle, rotary-type, Lees-Bradner vertical hobbing machine is used. It is so built that if one spindle requires repairs, the other five may still be kept in operation. The operator does not have to move from spindle to spindle, since the machine is rotated.

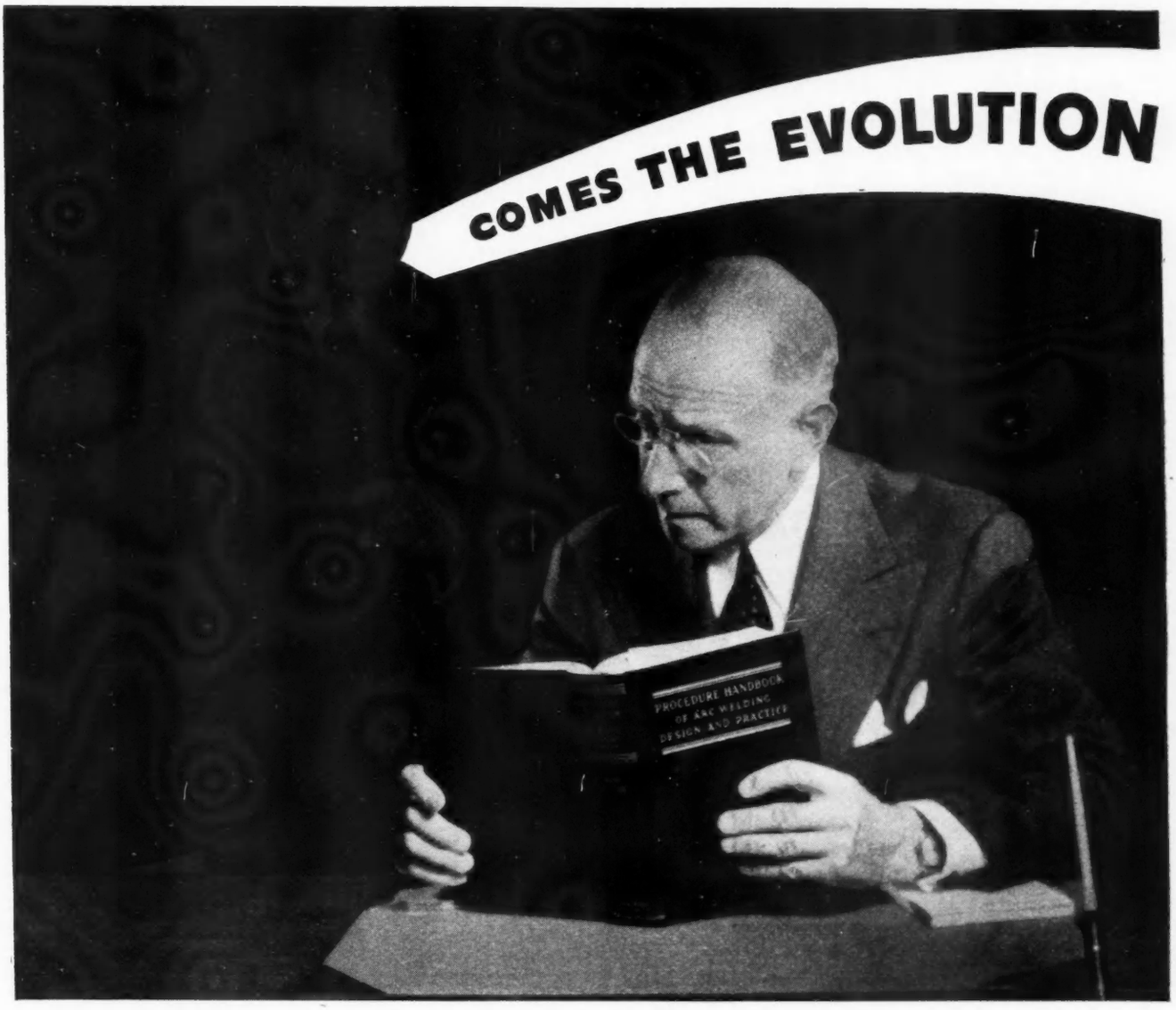


## Goodyear Gets Navy Contract for Blimps

Latest aircraft contracts awarded include a $131,306,962 order placed by the War Department with the Wright Aeronautical Corp., Paterson, N. J., for engines; a $122,323,020 order for 3000 engines with Ford Motor Co., Dearborn, Mich., and a $106,125,396 contract for airplanes with the Glenn L. Martin Co., Baltimore. Although ordered by the Army, the contract with the Wright company also calls for an undisclosed number of naval aircraft.

The War Department also awarded a $4,294,789 contract for plant expansion by the Vultee Aircraft, Inc., Downey, Cal. Under the terms of the so-called emergency plant facility contract, the company supplies the funds, the government repays the cost within five years, after which the firm can purchase the facilities at cost or transfer title to the government.

An undisclosed number of blimps will be constructed by the Goodyear Aircraft Corp., Akron, under a $1,324,000 order placed by the Navy Department.




ALTER EGO: Literally "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

**ALTER EGO:** "Now pity a sorrier fate if you can: A vagabond soul in a stay-at-home man." Remember that poem?

*Meaning what?*

**ALTER EGO:** Meaning you're that way about arc welding. You'd like to improve your product and enjoy the saving in cost—BUT you'd rather sit comfy with the old familiar production process.

*But we haven't the* time *these days to change barrels while going over Niagara Falls.*

**ALTER EGO:** Then don't change barrels. The most rabid redesign enthusiast will tell you that redesign for arc welding is a matter of evolution, not revolution.

*You mean we should do it one step at a time—like learning to walk?*

**ALTER EGO:** Exactly, then when you've perfected the production of one part, take the second step —redesign the next part; and before you know it, you and the product are on the way to town.

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LINCOLN SUGGESTS: To the man who thinks he hasn't time or who doesn't know how to change over to welding, we offer this suggestion: See how others, with problems like your own, have started out with welded design. The booklet, "How to Changeover to Welded Design for Profits" (gratis) gives the evidence and a start.

**LINCOLN "SHIELD-ARC" WELDING** THE LINCOLN ELECTRIC COMPANY Cleveland, Ohio

Authoritative Information on Design • Production • Welding Equipment

# Modern Fuels and Lubricants for Diesels

(*Continued from page* 587)

Carbon formation in the combustion chamber usually is of interest only if it occurs immediately above the range of top-ring travel; if hard, adherent carbon forms there it is apt to cause excessive scuffing of the top land of aluminum pistons. Accumulation of hard carbon behind the top ring usually proves disastrous through interfering with free action of the ring in following the cylinder wall. If a jet of oil is directed against the under side of the piston crown for cooling purposes, an oil of high carbon-forming tendency may lead to excessive coke formation on the under side of the crown, especially if the engine is loaded intermittently.

The ideal oxidation inhibitor is one capable of bringing all stocks to about the same degree of oxidation resistance. Such an inhibitor may not yet have been invented, said the author, but there are now inhibitors in commercial use which make a tremendous improvement in the oxidation resistance of certain oils in the presence of oxidation catalysts (such as some of the soaps used for compounding oils proved to be).

As regards the prevention of bearing corrosion, it was found that the loss of lead from an eventual disintegration of copper-lead bearings was due to the development of corrosive acids of relatively low molecular weight, through the catalytic oxidation of the base oil. The conclusion was, therefore, reached that the safest way to prevent bearing corrosion was to prevent oxidation of the base oil. As a further precaution the addition of corrosion inhibitors seemed logical, and as a final defense it was proposed to incorporate in the oil a class of compounds which would constitute a source of reserve alkalinity capable of neutralizing corrosive acids if and when they developed. The author said a formula involving all three provisions was developed and is now being used in several different base oils for the lubrication of all makes of Diesel manufactured in this country. Fortunately, the sulfur in the oxidation inhibitor also furnishes additional film strength.



### *Diesel Fuels for Easy Starting*

DR. L. A. BLANC of the Research Department of Caterpillar Tractor Company presented a paper on "An Attempt to Develop a Special Diesel Fuel for Easy Starting." Experiments were made on a single-cylinder test engine, jacket-water and air-inlet temperatures being held constant. The engine was cranked over at a certain speed, and six to eight successive fuel injections were made; if the engine failed to pick up, the result was put down as "no start." The lowest speed at which the engine could be started was taken as an inverse measure of the ease of starting for the fuel under test. Tests were made with a variety of simple and treated or doped fuels. With kerosene the engine, as a rule, started at quite low speeds, but kerosene is an unsuitable Diesel fuel because it lacks the lubricating qualities that are called for by the injection pump and injection nozzle. Gas oils required higher cranking speeds for starting, but it was found that their starting qualities could be improved by the addition of certain compounds such as sulfur dioxide, diethyl ether, and dibutyl ether. Far greater improvement in starting ease could be achieved by design changes than by changes in the fuel, but some of the design changes made to facilitate starting were harmful from the standpoint of engine performance.

In the discussion, questions were asked as to the effects of such fuel characteristics as volatility, viscosity, and ignition quality on the ease of starting. The author in reply said that so far the investigation had been carried on chiefly from the standpoint of the effects of changes in chemical composition, and the effects of changes in the physical properties on starting ease had not been investigated.